V.S.B. ENGINEERING COLLEGE, KARUR

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC YEAR 2018-19 (ODD SEMESTER)

2 MARK AND 16 MARK QUESTION BANK

CLASS IV YEAR/ VII SEMESTER

EE6701-HIGH VOLTAGE ENGINEERING

TWO MARK QUESTIONS WITH ANSWERS

UNIT - I

OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS

1. **State the different types of over voltages occurring in power system and mention their magnitude.**
   (i) Switching an open ended line with
   a) Infinite bus as source with trapped charges on line. - 4.1
   b) Infinite bus as source with trapped charges on line. -2.6
   c) Deenergizing an unfaulted line with a line to ground fault. – 1.3
   d) Deenergizing an unfaulted line with a restrike in the circuit breaker – 2.7
   (ii) a) Switching a 500 kV line through an auto transformer 220 kV / 500 kV from the LV side. -2.0
   b) Switching a transformer terminated line. – 2.2
   c) Series capacitor compensated line with 50 % compensation. – 2.2
   d) Series capacitor compensated line with shunt reactor compensation. - 2.6
   (iii) High speed reclosing of the line after fault clearance. – 3.6

2. **Define indirect stroke.**
   In indirect stroke a negative charge in a cloud cause bound positive charges on the conductor of a nearby transmission line.

3. **What are the techniques to be adopted for controlling the switching over voltages?**
   a) Installation of shunt reactors.
   b) Use of pre insertion resistor.
   c) Synchronous reclosing and simultaneous operation of CB at both end.
   d) Use of surge arrester and elimination of trapped charges by line shunting after opening by means of earthling switch.
   e) Use of surge absorber or resistance switching.

4. **What is a surge arrester?**
   Surge arrester is a revolutionary advanced surge protective device for power system. It is constructed by a series connection of zinc oxide elements having a highly non linear resistance.

5. **What are the causes of power frequency over voltages?**
   The causes for power frequency and harmonic over voltages in EHV and UHV systems are:
   Sudden load reflection (loss of loads)
   a) Disconnection of inductive loads or connection of capacitive loads.
   b) Ferranti effect.
   c) Unsymmetrical faults.
   d) Saturation in transformers, etc,
   e) Tap charging operations.

6. **What are the causes of over voltages in power system?**
   The causes of over voltages in power system may be internal cause or external cause.
   Internal causes of over voltages are
   a) Switching Transients
   b) Arcing ground
   c) Insulation failure
   d) Resonance
   External cause for over voltages are Lightning.

7. What are the different types of fault that may occur on power lines?

i) Symmetrical faults - 3Φ fault (LLLG)

ii) Unsymmetrical faults

a) L-G fault

b) L-L fault

c) L-L—G fault

8. Explain why a simple spark gap cannot offer full protection against over voltages.

There is no current limiting device provided so as to limit the current after spark over. Hence a series resistance is often used. Without a series resistance the sparking current may be very high

Ant the applied impulse voltage collapses to zero thus creating steep step voltage which sometime proves to be dangerous to the apparatus to be protected such as transformer or machine. Their flash over characteristics depends on the atmospheric condition, polarity of wave and wave shape.

9. What is insulation co-ordination?

Insulation co-ordination means the correlation of the insulation of various equipments in a power system to be insulation of protective devices used for the protection of those equipments against over voltage.

10. Name the sources of switching surges.

a) Opening and closing of switchgears.

b) In circuit breaker operation, switching surges with a high rate of rise voltage may cause repeated restriking of the arc between the contacts of the CB.

c) High natural frequencies of the system.

d) Damped normal frequency voltage components.

e) Restriking and recovery voltage with successive reflected waves from terminations.

11. Define surge impedance of transmission line.

The characteristic impedance of a line is the surge impedance of transmission line. It is given by

$Z_0 = \sqrt{R + jwL / G + jwC}$

12. Mention the different kinds of over voltages.

a) Over voltage due to lightning.

b) Over voltage due to switching transients.

c) Over voltage due to arcing ground.

d) Over voltage due to insulation failure.

e) Over voltage due to resonance.

13. What is meant by switching surges? Mention the approximate magnitude of switching surges and their frequency.

The switching voltage surges, occur during and closing of unload EHV Ac lines breaking inductive loads, breaking capacitive loads etc.

The switching voltage surges are of comparatively longer duration 2500 μs lower rate of rise. The peak value of switching surge is expressed in terms of switching over voltage factor. Switching surges can be of the order 2 to 3.3 pu and will have the magnitudes of the order 1200 kV to 2000 kV.

14. What are the chief causes of over voltages in electric power system?

1) Lightning over voltages (Natural causes)

2) Switching over voltages (system oriented causes)

15. How are switching over voltages originated in a power system?

Switching over voltages originate in the system itself by the connection anddisconnection of circuit breaker contacts or due to initiation or interruption of faults.

16. What are switching over voltages?

Switching over voltages are highly damped short duration over voltages. They aretemporary over voltages of power frequency or its harmonic frequencies.

- They are sustained or weakly damped
- They originate in switching and fault clearing process.

17. For ultra high voltages, perhaps, switching surges may be the chief condition for designconsiderations. Why?

The magnitudes of lighting voltages appearing on a transmission line do not depend online design hence lightning performance does not improve with increasing insulation level, thatis, the system voltage. On the other hand switching over voltages is proportional to operatingvoltage. Hence for ultra high voltages switching surges may he the chief condition for consideration.

18. How are lightning strokes on transmission lines classified?

1) Direct strokes 2) Inducted strokes

Direct stroke:

When thunder cloud directly discharges on to a transmission line tower or line wires, it iscalled direct stroke. This is the most severe form and this occurs rarely.

Inducted Stroke:

When thunder storm generates negative charges at its ground end. The transmission lineand Tower develop induced positive charges. Normally lines are unaffected, because they areinsulated by string insulators. However, because of the high field gradients involved, the positivecharge leak from the Tower along the insulator surfaces to the live conductors, after a few microseconds, (say). When the cloud discharges through some earthed objects other than thetransmission line, huge concentration of positive charge is left with.

- The transmission line and earth act as a huge capacitor.
- This may result in a stroke and hence the name inducted lightning stroke.

19. What is Back Flashover?

Some times when a direct lightning stroke occurs on tower if the tower footing resistanceis considerable, the potential of the tower rises to a large value, in view of the huge lightningstroke current, steeply with respect to the line and consequently a flash over may take place,along the insulator string. This is known as Back Flashover.

20. Give the mathematical Model for lightning?

Let

Io – lightning current (current source)
Zo – source impedance (of the cloud)
Z - object Impedance
V - Voltage built across the object

Then

$V = I.Z$
$= Io\ (Zo/Z + Zo)Z$
$= Io. /(1 + (Z / Zo))$
$Zo = 1000$ to 3000 ohms (generally)
Z = object Impedance
Tr line : 300 to 500 ohms
Ground wire : 100-150ohms
Tower : 10-50 ohms

Therefore

Z/Zo=less and can be neglected.

Therefore

$V= Io.Z$

Where

Io = lightning stroke current
Z = surge impedance.

UNIT II
ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS

1. Define Gas Law.

It consists of many laws. The following laws are very important.

a) Charle's law P α T Volume is constant
b) Boyle's law P α 1/V T is constant
General equation: PV = nRT
Where
P-pressure ; V-Volume; n-number of moles; R-molar gas constant; T-temperature.

2. What is Paschen's law?

$f_2(V|pd)[\exp\{\text{pdf1}(\text{V}|\text{pd})\} - 1\ ] = 1$

This equation shows a relationship between V and pd , and implies that the breakdown voltage varies as a product pd varies knowing the nature of functions f_1 and f_2 we can rewrite this equation

V = f (pd)

Where

P - Gas pressure f - function
d - the electrode of dp V - Voltage

3. Which insulation is used in high voltage circuit breakers of large power rating?

Now a day's most of all circuit breakers that are in operation use SF6 gas or vacuum as insulating medium. SF6 circuit breakers are manufactured up to the higher transmission voltage of 800 kV and current range of 63 kA and 80 kA. However it is an expensive gas and at the normal operating pressure of 6 bar it condenses at temperatures lower than 20°C.

4. What is Time lag in the breakdown of dielectrics?

The time that elapses between the application of the voltage to a gap sufficient to cause breakdown and actual breakdown is called time lag.

5. Define uniform and non uniform field and give examples of each.

In uniform field the applied field remains constant across the gap. Example: The field between the two plane electrodes.
In non uniform field the applied field varies across the gap.
The examples are coaxial cylinders, point- plane and the sphere plane gaps.

6. Define the following as applied to high voltage breakdown.

a) Internal and External insulation
b) Flashover

a) Internal and External insulation
Disruptive discharge voltage produces the loss of dielectric strength of insulation. It is the voltage at which the electrical stress in the insulation causes a failure which includes the collapse of voltage and passage of current.

b) Flashover
When discharge takes place between two electrodes in gas or liquid over a solid surface on air it is called flashover.

7. Define the following as applied to disruptive voltage.

a) Flashover voltage
b) Spark over voltage

a) Flashover
When discharge takes place between two electrodes in gas or liquid over a solid surface on air it is called flashover.

b) Spark over voltage

The voltage between two spheres on sphere gap is raised till a spark passes between two spheres. The value voltage of spark over depends upon the dielectric strength of air, size of sphere and distance between the sphere and other factors.

8. What is meant by Townsend discharge and explain its main feature?

When the voltage between anode and cathode is increased the current in the anode equals the current in the external circuit. Therefore the current becomes infinitely large under the above mentioned condition but practically it is limited by the resistance of external circuit and practically by the voltage drop in the arc. The condition $Ve^{\alpha c} = 1$ defines the condition for the beginning of spark and is known Townsend criterion for spark formation or breakdown.

9. What are the different theories related with liquid dielectric breakdown?

The first theory is extension of gaseous breakdown based on the avalanche ionization of atoms caused electron collision in the applied field. The second theory is based on the fact the presence of foreign particles in liquid insulation is polarizable and is of higher permittivity than the liquid.

10. Distinguish between insulators and dielectrics and give examples for each.

A dielectric is a non conducting substance ie, an insulator. Although the dielectric and insulator are generally considered synonymous the term dielectric is more often used to describe the material where the dielectric polarization is important like the insulating material between the metallic plates of a capacitor while insulator is more often used when the material is being used to prevent a current flow across it.

Examples of insulators: Glass and porcelain

Examples of dielectric: Paper and Mica

11. What are Meta stable atoms? How they are ionizing the gaseous dielectric medium?

A Meta stable atom or a molecule is an excited particle whose life time is very large (10^{-3} sec) compared to the life time of an ordinary particle. Meta stables have a relatively high potential energy and are therefore able to ionize neutral particles.

12. Define formative time lag.

After the appearance of the electron a time t_f is required for the ionization processes to develop fully to cause the breakdown of the gap and this time is called formative time lag.

13. What is composite dielectric?

It is difficult to imagine complete insulation system in electrical equipment which does not consist of more than one type of insulation. If insulation as a whole is considered, it will be found that more than one insulating material is used. These different materials can be in parallel with each other such as air or SF6 in parallel with solid insulation or in series with one another. Such insulation systems are called composite dielectrics.

14. What are the physical conditions governing ionization mechanism in gases dielectrics?

1) Pressure
2) Temperature
3) Electrode configuration
4) Nature of electrode surface
5) Availability of initial conducting particles

15. What is primary ionization?

Electron produced at the cathode by some external means, during its travel towards theanode due to the field applied, make collisions with neutral atoms/molecules and liberateelectrons & positive ions. The liberated ions make future collisions and the process continue. Theelectrons and the ions constitute current. This process is called primary ionization.

16. What is secondary ionization?

- The librated positive ions, during the primary ionization process migrate towardscathode bombard and emit secondary electrons from the cathode.
- The excited atoms/molecules,got excited during the collision of initial electrons,emit photons which bombard the cathode & emit secondary electrons

17. Demerits of Town-sends theory?

1. Beyond a p.d > 1000 torr cm, this theory does net explain correctly.
2. Town sends theory says that current growth depends on ionization. But actually itdepends on gas pressure and geometry of gap.
3. Town sends mechanism predicts time lag of 10-5 sec. But actually the time lag is 10-8sec.
4. The discharge form is not as the one predicted by Town-sends theory. It is filamentary& irregular and not "diffused form" as predicted by town-sends.

18. Streamer theory is based on what?

- Streamer theory considers the influence of space charge on the applied field.
- Secondary avalanches are produced from the gap
- Transformation from avalanche to streamer occurs when the length of avalanche exceedsa certain value.
- Streamer theory overcomes the demerits of Town-sends theory.

19. Distinguish between BD in uniform field and BD in Non uniform field?

1. In the uniform field, increase in applied voltage produces a Breakdown in the gap inthe form of a spark without any preliminary discharge.
2. In the non uniform field, an increase in applied field, first cause a discharge inm thegas around the points where the field is the highest. (Eg. Sharp Points, Curves of electrode). Thisfrom of discharge is called corona discharge, which extends finally as the field is increased and bridges the gap between the electrodes ultimately & cause BD.

20. What are the characteristics of corona discharge?

1. It has bluish luminescence.
2. It produces hissing noise.
3. Air surrounding the corona becomes converted to ozone.
4. Creates loss of Power.
5. Create radio interference.
6. It causes deterioration of the insulation surface.

UNIT III
GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS

1. Give some uses of HVDC.

Generation of high d.c voltages is mainly required in research work in the areas of pure and applied physics. Sometimes high direct voltages are needed in insulation tests on cables and capacitors. Impulse generator charging units also require HVDC of about 100 to 200 kV. Normally for the generation of dc voltages of up to and the output currents are about 100 mA.

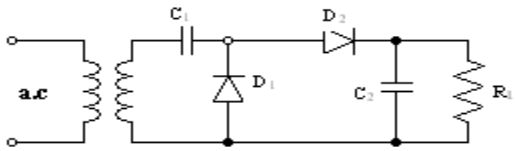
2. What are the applications of impulse current wave forms of high magnitude?

Generation of impulse current waveforms of high magnitude (100 kA peak) find application in test work as well as in basic research or non linear resistors, electric arc studies relating to electric plasmas in high current discharges.

3. **How are capacitances connected in an impulse current generator?**
For producing impulse currents of large value a bank of capacitors are connected in parallel and are charged to a specified value and are discharged through a series R.L circuit.

4. **What type of wave form will be available in impulse current generator output?**
Damped wave or damped oscillatory wave.

5. **Draw a circuit diagram of simple voltage doublers.**



6. **Write the expressions to find the optimum number of stages and % ripple in a voltage multiplier circuits.**
Optimum number of stage = $\sqrt{V_{max} f_c / I}$
I = load current and opt % ripple voltage = $[nI_1 / f_c]$

7. **Draw a simple Tesla Coil equivalent circuit for generation of high frequency A.C high voltage.**

8. **Write an expression to find the % ripple and % voltage regulation in a multi stage voltage multiplier circuit.**
% ripple = $\frac{I_1}{f_c} \frac{n(n+1)}{2}$

% regulation = $I_1 / f_c [(2/3)n^3+n^2-n/6]$

9. **Explain the superiority of cascaded transformer over two winding transformer.**
   a) Natural cooling is sufficient.
   b) Transformers are compact in size, so the transportation and assembly is easy.
   c) Construction is identical.
   d) Three phase connection in star or delta is possible.

10. **An impulse generator has 10 stages with capacitors rated 0.15 µF and 150 kV per stage. The load capacitor is 1000 pf. Find the front and tail resistance to produce an impulse of 1.2 / 50 µs (approximate formula).**
G.D
Number of stage = 10
solution
C_1 = Generator capacitance = [0.15/10] = 0.015 µF
C_2 = Load capacitance = $[1000/10^{12}] = 10^{-9}$ F
To find Front resistance
Front time = 1.2 µ sec
t_1 = 3 * time constant when neglecting R_2
$t_1 = 3 * R_1[C_1C_2/C_1 + C_2]$
R_1 = 426.67 Ω
Tail time t_2 = 50 µ sec
$t_2 = 0.7(R_1 + R_2) (C_1 + C_2)$
R_2 = 4037.63 Ω

11. Define the specification of impulse voltage as per Indian standard.

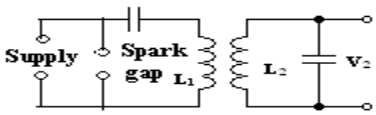
Standard impulse have a rise time of 0.5 µ s and 10 µ s and decay time of 50 % of peak value and of the order of 30 to 200 µ s.

12. What is the need for generating impulse currents?

Generation of impulse current waveforms of high magnitude find application in testing work as well as in basic research in nonlinear resistors electric arc studies and studies relating to electric plasmas in high current discharges.

13. What is a tesla coil?

Tesla coil is a high frequency resonant transformer. It is a doubly tuned resonant circuit as shown in the following figure.



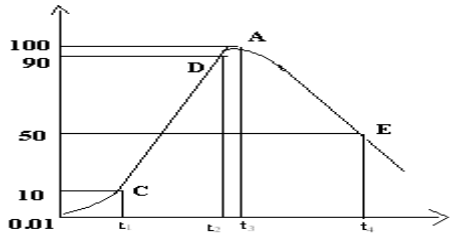
14. What are the factors influencing the measurements using sphere gap?

The factors influencing the measurements using sphere gap

a) Influence of nearly earthed objects.
b) Influence of humidity.
c) Influence of dust particles

15. Define the front and tail times of an impulse wave.

Referring to wave shape the peak value A is fixed and referred to as 100 % value. The points corresponding to 10 % and 90 % of peak values are located in the front time portion points C & D. The line joining these points is extended to cut the time axis at 0.1. Here 0.1 is taken as the virtual origin. 1.25 times the interval between times t_1 and t_1 corresponding to points C 7 D is defined as front time 1.25[o_1 t_1 = o_2 t_2]. The point E is located on the wave tail corresponding to 50 % of peak value and ot_4 is defined as the tail time.



16. What is the necessity for generating high voltages?

- Applications like electric microscope, X rays, particle accelerators, Electrostatic precipitators etc.
- Testing power apparatuses.
- Insulation testing.

17. What are the various methods available for generating High DC voltage?

1. Half & full wave rectifiers.
2. Voltage multiplayer circuits.
   - Cockcraft Walten Circuit
   - Delta-tran/Engi-tran
3. Van de graaff generators.
4. Electro static generators.

18. State the principle of Van de Graaff generator ?

Mechanical energy is directly converted into electrostatic, electrical energy (without anyelectromagnetic conversion, as in the case of an electromagnetic machine like synchronousgenerator).

19. How Impulse voltages are produced in the lab?

Capacitors previously charged to DC voltage is discharged into a wave shaping network(LR, R1 R2, R3 or other combination) by closing a switch. This gives the desired output (doubleexponential wave).

20. What is the principle of Marx circuit?

A bank of capacitors are charged in parallel and then discharged in series into a waveshaping network to produce a lighting impulse voltage, double exponential fast rising & slowdecaying voltage.

21. How switching Impulse voltage can be produced in the lab?

1. Impulse generator circuits can be used by suitably modifying the R1 & R2.2. Power Tr or Testing Tr, excited by dc voltages giving oscillatory wave (Tesla tal)

UNIT IV
MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS

1. What are the general methods used for measurement of high frequency and impulse currents?

The following methods used for measurement of high frequency and impulse currents

a) Potential divider with a cathode ray oscilloscope.
b) Peak voltmeters.
c) Sphere gaps

2. What is the high voltage d.c measurement techniques used?

The following techniques are used for measurement of high voltage dc.

a) Series resistance micro ammeter
b) Resistance potential-divider
c) Generating voltmeter
d) Sphere and other spark gaps

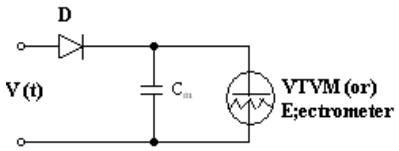
3. For what measurement are Hall generators normally used?

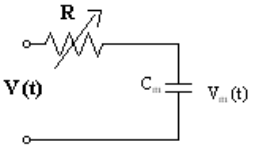
These are used for measurement of high direct currents. It can be used for measurement of unidirectional a.c impulse current also.

4. What type of measuring devices are preferred for measurement of Impulse currents of short duration?

Park's tubular shunt (or) coaxial tube is preferred for measurement of impulse current of short duration.

5. Draw the simple circuit of peak reading voltmeter and its equivalent.





6. List the factors that are influencing the peak voltage measurement using sphere gap.

The following are the factors

a) Nearby earthed objects
b) Atmospheric conditions and humidity
c) Radiation
d) Polarity and rise time voltage of waveforms.

7. **What are the advantages of CVT measurement in HVAC?**
   a) Simple design and easy installation
   b) Can be used both as a voltage measuring device for meter and relaying purpose and as a coupling condenser for power line carrier communication and relaying
   c) Frequency independent voltage distribution along elements as against conventional magnetic potential transformer which require additional insulation design
   d) Provides isolation between the high voltage terminal and low voltage testing.

8. **Why do we resort to statistical approach during breakdown due to impulse voltage?**
   The test is done with the specified voltage usually the probability failure is 40 % and 60 % failure values or 0 % and 80 % value since it is difficult to adjust the test for the exact 50 % flashover values. The average value of upper and lower limit is taken.

9. **State the demerits of CVT measurement for HVAC measurements.**
   a) Voltage ratio is susceptible to temperature variations.
   b) In the presence of capacitance and choke, the problem of ferro-resonance occurs in power system.

10. **What are high current shunts mention their design criterion?**
    The most common method employed for high impulse current is a low ohmic pure resistive shunt. The resistance shunt is usually designed in the following manner to reduce the stray effects.
    a) Bifilar flat strip design
    b) Coaxial cable or parts shunt design
    c) Coaxial squirrel cage design.

11. **Why are capacitive voltage dividers preferred for AC high voltage measurements?**
    The high voltage dividers are preferred for high ac voltage measurement because the capacitance ratio is independent of frequency.

12. **Calculate the correction factors for atmospheric conditions, if the laboratory temperatures is 37°C, the atmospheric pressure is 750 mm Hg and the wet bulb temperature is 27°C.**
    <u>Solution:</u>
    1013 millibar = 760 mm
    750 mm = 1013/7660 *750 = 1000 millibar
    Correction factor = $(0.296 * 1000|273 + 37)$ = 0.955

13. **Explain the merits and demerits of analog and digital techniques used for high voltage measurements.**
    Information storage is easy that is accomplished by special switching circuit that latches on information and holds it for as long as necessary. Accuracy and precision are greater. Digital system can handle as many digits of precision as you need simply by adding more switching circuits.
    Analog system is cheaper and involves less complex circuitry.

14. **What are the general methods used for measurement high frequency and impulse currents?**
    The following methods are used
    a) Resistive shunts
    b) Magnetic potentiometer or Rogowski coils
    c) Magnetic links
    d) Hall Effect generator.

15. **What is the Specialty of high voltage / current measurement?**
    1. Safety of men & materials.
    2. Accuracy
    3. Induction of over voltage, due to stray coupling.
    4. Proper location.

5. Linear extrapolation not valid.
6. Electro magnetic interference.

16. Different devices used for High DC voltages?

1. Series resistance micro ammeter.
2. Resistance potential dividers
3. Generating of Voltmeters
4. Sphere gap & Spark gaps.

17. What are the various methods used for measurement of power frequency AC voltages?

1. Series impedance ammeter.
2. Potential dividers, resistance or capacitive Type.
3. Potential Transformers electromagnetic or C. V. T.
4. Electrostatic voltmeters.
5. Sphere gap.

18. What is the method available for measurement & High frequency AC voltages or Impulse voltages or other rapidly rising voltages?

1. Potential dividers, resistance Type or capacitance Type with CRO.
2. Peak Voltmeter
3. Sphere gap

19. What are the various methods available for measurement of High Impulse currents or High frequency ac or fast rising ac?

1. Resistive shunts
2. Magnetic pot cut meter.
3. Magnetic links
4. Hall Effect generators.
5. Faraday generators.

20. What are the limitations of resistance potential dividers?

1. Power dissipation
2. Source loading
3. Temperature effect & long term stately
4. Sensitivity to Mechanical strain.
5. Direct connection to HV terminals.

UNIT 5
HIGH VOLTAGE TESTING AND INSULATING COORDINATION

1. What are tests conducted on insulators?

i) Power frequency voltage test
ii) Impulse voltage test

Power frequency test can be classified into

a) Dry and wet flashover tests
b) Wet and dry withstand tests (one minute)

Impulse tests can be classified into

a) Impulse withstand voltage test
b) Impulse flashover test
c) Pollution testing.

2. What are test conducted on Bushings?

i) Power frequency voltage test

ii) Impulse voltage test

Power frequency test can be classified into

a) Power factor voltage test
b) Internal or partial discharge test
c) Momentary withstand test at power frequency
d) One minute wet withstand test at power frequency test
e) Visible discharge test at power frequency

Impulse voltage tests can be classified into

a) Full wave withstand test
b) Chopped wave withstand and switching surge test

Temperature rise and thermal stability tests are also used for testing of bushings.

3. Define withstand voltage.

The voltage which has to be applied to attest object under specified condition in a withstand test is called the withstand voltage.

4. Define impulse voltage.

Impulse voltage is characterized by polarity. Peak value, time to front and time to half the peak value after the peak. The time to front is defined as 1.67 times to time between 30 5 and 90 % of the peak value in the rising portion of the wave. According to [s : 207] (1973) standard impulse is defined as one with t_f = 1.2 µs, t_t = 50 µs (called 1.250 µs wave). The tolerances allowed are ±3 % on the peak value, ±30 % in the front time (t_f), and ±20 % in the tail time (t_t).

5. Differentiate type test and routine test.

Routine test is not to flash over the insulator but rather to detect existing fault before the insulator is put in service .Type test cover those features that are important to the purchaser such as dry and wet flash over, puncture voltage, tensile strength.

6. Define Disruptive discharge voltage.

This is defined as the voltage which produces the loss of dielectric strength of an insulation. It is that voltage at which the electrical stress in the insulation causes a failure which includes the collapses of voltage and passage of current.

7. What are the atmosphere correction factor and mention their influence in high voltage testing.

Actual air density during measurement differs due to temperature and pressure variation.

Spark over voltage depends upon the air density factor

Spark over voltage $V = KV_0$

Where ,K = Correction factor related to air density factor'd'

V_0 = Spark over voltage under standard temperature and pressure.

$d = P/P_0[(273 + t_0) / (273 + T)]$

Where

K is a function of air density factor d

P = air pressure at test condition

P_0 = air pressure at standard condition

t_0 = temperature at standard condition

T = temperature at test condition

8. Explain the role of Bureau of Indian standards in high voltage testing.

All the EHV equipment voltage are governed by Indian standard specification issued by Bureau of Indian standards in our country.

For different transmission voltages the test voltages are given in a tubular form.

9. **Define insulation co- ordination.**
   Insulation co-ordination of suitable values for the insulation levels of the various components in any electrical system and their management in a rational manner is called insulation co-ordination Insulation co-ordination of the insulation of the electrical equipment and circuits with the characteristics of the protective devices in such a manner that the insulation is well protected from the excessive over voltages.

10. **What is the significance of impulse tests?**
    Impulse test are done on insulator to ensure reliability of individual test objects and quality and consistency of material used in their manufacture and done on transformers is to determine the ability of the insulation of transformers to withstand the transient voltages due to lightning.

11. **Name the different types of tests conducted on high voltage apparatus.**
    Dry -Wet flashover test and Dry -Wet withstands test are the two types of tests conducted on high voltage apparatus.

12. **Explain the reasons for conducting wet tests on high voltage apparatus and give the specifications of the water used for wet tests.**
    Wet tests are to provide a criterion based on experience that a satisfactory service operation will be obtained.
    Conductivity of water 100 microsiemens ± 10 %
    Water temperature ambient ± 15 %

13. **Define creepage distance.**
    It is the shortest distance of contour of the external surface of the insulator unit or between two metal fittings on the insulator.

14. **Give the Indian standard reference atmospheric conditions for high voltage testing.**
    a) Temperature - 27°C
    b) Pressure - 1013 millibars (or 70 torr)
    c) Absolute humidity – 17 gm/m^3

15. **Define safety margin as applied to be insulation co-ordination.**
    Safety margin applied to insulation co-ordination is the basic insulation level of equipment is defined as the peak voltage of 1.2 / 50 µs wave which does not cause insulation to fail. The definition of a surge (1.2 / 50 µs) indicates a surge which reaches its peak value in 1.2 µs and decays to half the peak in 50 µs.

16. **What is the specialty of HV Testing?**
    1. The H.V. lab requires higher space.
    2. Special equipments are required.
    3. Special Techniques are required.

17. **Name how standards for HV Testing**
    1. B I S - Bureau of Indian Standards.
    2. I E C - International Electro Tech. Commission.
    3. B S I - British Standard Institution.
    4. I E E E - Instituting Electrical & Electronics Engineering.
    5. I S O P - International Standards Organization.
    6. A N S I - American Standards Institute
    7. C I G R E - International council on large electrical system.
    8. ISS - Indian Standard Specifications

18. **Define Creepage Distance.**
    It is the shortest distance on the contour of the external surface of the insulator that is between the two metal fittings on the insulator

19. Define AC Test Voltage

Alternating current voltage of frequency 40 to 60 Hz, approximately sinusoidal(7% deviation is permitted) is called AC Test voltage.

20. Impulse voltage

It is a fast rising slow decaying voltage, characterized by its peak value, time to front and time to half value.

Standard Impulse Voltage

1. Peak : Tolerance ±3%
2. Time to Front : T f 1.2microsec ±30%
3. Time to half value : Tt 50microsec ±20%

Standard Switching Voltage

1. Peak : Tolerance ±3%
2. Time to Front : 250microsec ± 20%
3. Time to half value : 2500microsec ±

16 MARK QUESTIONS

PART-B

UNIT – I - OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS

1. Draw the cross sectional view of non linear resistor lightning arrester (valve type) and explain its operation in detail and its V-I characteristics.

2. Discuss mechanism of lightning stroke and over voltages on transmission lines and give its mathematical model.

3. Write short notes on:
   (i) Rod gaps used as protective devices
   (ii) Ground wires for protection of overhead lines.

4. Explain different theories of charge formation in clouds.

5. Explain different methods employed for lightning protection of overhead lines.

6. (i) Draw & Explain the procedure to draw Bewley Lattice Diagram for a two substations system .
   (ii) Explain briefly about expulsion type arrester.

PART-B

UNIT – II - ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS

1. Deduce the Townsend's break down criteria. Also define the Townsend's Primary and secondary ionization coefficients.

2. (i) Explain clearly breakdown in non-uniform fields & corona discharges.
   (ii) Explain breakdown in uniform field (streamer mechanism).

3. Explain the various theories of breakdown mechanism of vacuum.

4. State the criteria for sparking potential and hence obtain the relation between sparking potential and (PD) values (Paschens law). Discuss nature of variation of sparking potential with PD values.

5. Explain the various theories of breakdown mechanism of commercial liquid dielectrics.

6. Explain the various breakdown mechanisms involving in solid dielectric breakdown

PART-B

UNIT – III - GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS

1. What is the principle behind the electrostatic method of energy conversion? Explain the construction and operation of vandegraff generator with neat sketch.

2. Starting from basic marx circuit develop the circuit of modern multistage impulse generator and explain its operation. Discuss significance of various parameters.

3. Explain the operation of simple voltage doubler circuit & Cockcroft -Walton voltage multiplier circuit with expression.

4. Explain in detail about cascade transformer connections and resonant transformer to generate high alternating voltage.

5 .Explain in detail how the impulses current is generated using capacitor bank & also explain tripping & control of impulse generators with Trigatron gap Arrangement.

6. A ten stage Cockraft-Walton circuit has all capacitors of 0.04 μF. The secondary voltage of the supply transformer is 120 kV at a frequency of 150 Hz. If the load current is 1.2 mA, determine (1) voltage regulation (2) the ripple (3) the optimum number of stages for maximum output voltage (4) the maximum output voltage.

7. A 12 stage impulse generator has 0.126microF capacitors .The wave front & wave tail resistances are 800 ohms and 5000 ohms respectively. For a load capacitor of 1000pF, obtain the front and tail times of the impulse wave produced.
8. A 8 stage impulse generator has 0.12microF capacitors rated for 167 KV. What is the maximum discharge energy? If it has to produce 1/50 micro second waveform across a load capacitor of 1500 Pico Farad, find the value of front and tail timings.

PART-B

UNIT – IV - MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS

1. Explain measurements of very high voltages using sphere gaps. Mention merits and de merits of using sphere gaps& also explain digital peak voltmeter & rod gaps.

2. With a neat sketch explain the principle of operation of an electrostatic voltmeter for HVAC measurement. What are the merits and demerits?

3. Explain generating voltmeter for measuring high DC voltage.

4. What is CVT? Explain through phasor diagram how a tuned CVT can be used for HVAC measurement in substations. & also expain series capacitor peak voltmeter.

5. Explain the methods of measurement of high frequency current.

6. Explain the methods of measurement of high impulse current.

PART-B

UNIT – V - HIGH VOLTAGE TESTING AND INSULATING COORDINATION

1. With a neat sketch explain the impulse testing on the power transformer.

2. Discuss the various test carried out in a circuit breaker at HV labs.

3. What are the different power frequency tests done on bushings? Mention the procedure for testing.

4. Briefly discuss the various tests carried out the insulator.

5. What is meant by insulation coordination? How are the protective devices chosen for optimal insulation level in a power system?

6. Explain the terms:
   (i) With stand voltage (ii) Flash over voltage
   (iii) 50% flash over voltage (iv) Wet and dry power frequency tests as referred to HV testing.

7. Explain the following terms used in HV testing as per the standards:
   (i) Disruptive discharge voltage (ii) Creepage distance
   (iii) Impulse voltage (iv) 100% flash over voltage.

8. (i) What are the tests conducted on circuit breakers and isolator switches?
   (ii) What are different tests conducted on cables? Explain any one of them.

EE 6702 -PROTECTION AND SWITCHGEAR

TWO MARKS QUESTION &ANSWERS

UNIT I PROTECTION SCHEMES

1. **What are the functions of protective relays?**
   To detect the fault and initiate the operation of the circuit breaker to isolate the defective element from the rest of the system, thereby protecting the system from damages consequent to the fault.

2. **What is back up protection?**
   Is the second line of defence, which operates if the primary protection fails to activate within a definite time delay.

3. **How does the over voltage surge affect the power system?**
   The over voltage of the power system leads to insulation breakdown of the equipments. It causes the line insulation to flash over and may also damage the nearby transformer, generators and the other equipment connected to the line.

4. **What are symmetrical components?**
   It is a mathematical tool to resolve unbalanced components into balanced components.

5. **Define negative sequence component.**
   It has 3 vectors equal in magnitude and displaced from each other by an angle 120 degrees and has the phase sequence in opposite to its original phasors.

6. **Give the consequences of short circuit.**
   Whenever short-circuit occurs, the current flowing through the coil increases to an enormous value. If protective relays are present, a heavy current also flows through the relay coil, causing it to operate by closing its contacts. The trip circuit is then closed, the circuit breaker opens and the fault is isolated from the rest of the system. Also, a low voltage may be created which may damage systems connected to the supply.

7. **What is the need of relay coordination?**
   The operation of a relay should be fast and selective, ie, it should isolate the fault in the shortest possible time causing minimum disturbance to the system. Also, if a relay fails to operate, there should be sufficiently quick backup protection so that the rest of the system is protected. By coordinating relays, faults can always be isolated quickly without serious disturbance to the rest of the system

8. **State the various types of earthing.**
   Solid earthing, resistance earthing, reactance earthing, voltage transformer earthing and zig-zag transformer earthing.

9. **State the three sequence components.**
   Positive sequence components, negative sequence components and zero sequence components.

10. **State the different types of faults.**
    Symmetrical faults and unsymmetrical faults and open conductor faults.

11. **Define protected zone.**
    Protected zones are those which are directly protected by a protective system such as relays, fuses or switchgears. If a fault occurring in a zone can be immediately detected and or isolated by a protection scheme dedicated to that particular zone.

12. **What are the various faults that would affect an alternator?**
    (a) Stator faults
    1, Phase to phase faults

2, Phase to earth faults
3, Inter turn faults

(b)
1, Earth faults
2, Fault between turns
3, Loss of excitation due to fuel failure

(c) 1, Over speed
2, Loss of drive
3, Vacuum failure resulting in condenser pressure rise, resulting in shattering of the turbine low pressure casing

(d) 1, Fault on lines
2, Fault on bus bars

13. What are arcing grounds?

The presence of inductive and capacitive currents in the isolated neutral system leads to formation of arcs called as arcing grounds.

14. Define positive sequence component. and zero sequence component

Positive Sequence components have 3 vectors equal in magnitude and displaced from each other by an angle 120 degrees and having the phase sequence as original vectors.

Zero sequence components have 3 vectors having equal magnitudes and displaced from each other by an angle zero degrees.

15. State the various types of unsymmetrical faults.

Line to ground, line to line and double line to ground faults

16. What are unit system and non unit system?

A unit protective system is one in which only faults occurring within its protected zone are isolated. Faults occurring elsewhere in the system have no influence on the operation of a unit system. A non unit system is a protective system which is activated even when the faults are external to its protected zone.

17. Define single line diagram.

Representation of various power system components in a single line is defined as single line diagram.

18. What is arc suppression coil?

A method of reactance grounding used to suppress the arc due to arcing grounds.

19. State the significance of double line fault.

It has no zero sequence component and the positive and negative sequence networks are connected in parallel.

20. Mention the withstanding current in our human body.

9mA

21. What is primary protection?

Primary protection is the protection in which the fault occurring in a line will be cleared by its own relay and circuit breaker. It serves as the first line of defense.

22. What are the different types of earthing ?

i) resistive earthing ii) reactance earthing iii) resonant earthing

23. State the significance of single line to ground fault.

In single line to ground fault all the sequence networks are connected in series. All the sequence currents are equal and the fault current magnitude is three times its sequence currents.

24. Differentiate between a fuse and a circuit breaker.

Fuse is a low current interrupting device. It is a copper or an aluminum wire. Circuit breaker is a high current interrupting device and it act as a switch under normal operating conditions.

25. Define per unit value.

It is defined as the ratio of actual value to its base value.

26. What is surge absorber? How do they differ from surge diverter? (nov/dec 2011)

Surge absorber is a device designed to protect electrical equipment from transient high voltage to limit the duration and amplitude of the following current. Surge diverter discharge the impulse surge to the earth and dissipates energy in the form of heat.

27. Define the term "insulation coordination" (nov/dec 2011)

Grading of withstand level of apparatus/equipment with the protective levels of surge arresters and co-ordination at entire voltage level and various other voltae levels.

UNIT II - ELECTROMAGNETIC RELAYS

1. Name the different kinds of over current relays.

Induction type non-directional over current relay, Induction type directional over current relay & current differential relay.

2. Define energizing quantity.

It refers to the current or voltage which is used to activate the relay into operation.

3. Define operating time of a relay.

It is defined as the time period extending from the occurrence of the fault through the relay detecting the fault to the operation of the relay.

4. Define resetting time of a relay.

It is defined as the time taken by the relay from the instant of isolating the fault to the moment when the fault is removed and the relay can be reset.

5. What are over and under current relays?

Over current relays are those that operate when the current in a line exceeds a predetermined value. (e.g.: Induction type non-directional/directional over current relay, differential over current relay) whereas undercurrent relays are those which operate whenever the current in a circuit/line drops below a predetermined value.(e.g.: differential over-voltage relay)

6. Mention any two applications of differential relay.

Protection of generator & generator transformer unit; protection of large motors and bus bars.

7. What is biased differential beam relay?

The biased beam relay is designed to respond to the differential current in terms of its fractional relation to the current flowing through the protected zone. It is essentially an over-current balanced beam relay type with an additional restraining coil. The restraining coil produces a bias force in the opposite direction to the operating force.

8. What is the need of relay coordination?

The operation of a relay should be fast and selective, i.e., it should isolate the fault in the shortest possible time causing minimum disturbance to the system. Also, if a relay fails to operate, there should be sufficiently quick backup protection so that the rest of the system is protected. By coordinating relays, faults can always be isolated quickly without serious disturbance to the rest of the system.

9. **Give the limitations of Merz Price protection.**
Since neutral earthing resistances are often used to protect circuit from earth-fault currents, it becomes impossible to protect the whole of a star-connected alternator. If an earth-fault occurs near the neutral point, the voltage may be insufficient to operate the relay. Also it is extremely difficult to find two identical CT's. In addition to this, there always an inherent phase difference between the primary and the secondary quantities and a possibility of current through the relay even when there is no fault.

10. **What is an under frequency relay?**
An under frequency relay is one which operates when the frequency of the system (usually an alternator or transformer) falls below a certain value.

11. **Define the term pilot with reference to power line protection.**
Pilot wires refer to the wires that connect the CT's placed at the ends of a power transmission line as part of its protection scheme. The resistance of the pilot wires is usually less than 500 ohms.

12. **Mention any two disadvantage of carrier current scheme for transmission line only.**
The program time (ie, the time taken by the carrier to reach the other end-upto .1% mile); the response time of band pass filter; capacitance phase-shift of the transmission line.

13. **What are the features of directional relay?**
High speed operation; high sensitivity; ability to operate at low voltages; adequate short-time thermal ratio; burden must not be excessive.

14. **What are the main types of stator winding faults?**
Fault between phase and ground; fault between phases and inter-turn fault involving turns of the same phase winding.

15. **What is static relay?**
It is a relay in which measurement or comparison of electrical quantities is made in a static network which is designed to give an output signal when a threshold condition is passed which operates a tripping device.

16. **What is a programmable relay?**
A static relay may have one or more programmable units such as microprocessors or microcomputers in its circuit.

17. **What is CPMC?**
It is combined protection, monitoring and control system incorporated in the static system.

18. **What are the advantages of static relay over electromagnetic relay? (nov/dec 2011)**
    - Low power consumption as low as 1mW
    - No moving contacts; hence associated problems of arcing, contact bounce, erosion, replacement of contacts
    - No gravity effect on operation of static relays. Hence can be used in vessels ie, ships, aircrafts etc.
    - A single relay can perform several functions like over current, under voltage, single phasing protection by incorporating respective functional blocks. This is not possible in electromagnetic relays
    - Static relay is compact
    - Superior operating characteristics and accuracy
    - Static relay can think , programmable operation is possible with static relay
    - Effect of vibration is nil, hence can be used in earthquake-prone areas
    - Simplified testing and servicing. Can convert even non-electrical quantities to electrical in conjunction with transducers.

19. **What is pick up value?**
It is the minimum current in the relay coil at which the relay starts to operate.

20. **Define target.**
It is the indicator used for showing the operation of the relay.

21. **Define reach.**
It is the distance up to which the relay will cover for protection.

22. **Define blocking.**
It means preventing the relay from tripping due to its own characteristics or due to additional relays.

23. **What are the different types of over current relays**
Instantaneous over current relays, Definite time over current relay, IDMT

24. **What is the purpose of plug setting?**
Plug setting is used to change the number of turns of the operating coil to get a particular pick up value.

25. **What is earth fault protection?**
The protective scheme used for the protection of an element of a power system against earth faults is called as earth fault protection

26. **A relay is connected to 400/5 ratio current transformer with current setting of 150%. Calculate the PSM when the fault current is 4000A (nov/dec 2011)**
4000/(7.5*80)=6.667

UNIT III APPARATUS PROTECTION

1. **What are the various faults to which a turbo alternator is likely to be subjected?**
Failure of steam supply; failure of speed; over current; over voltage; unbalanced loading; stator winding fault.

2. **What are the causes of over speed and how alternators are protected from it?**
Sudden loss of all or major part of the load causes over-speeding in alternators. Modern alternators are provided with mechanical centrifugal devices mounted on their driving shafts to trip the main valve of the prime mover when a dangerous over-speed occurs.

3. **What are the main types of stator winding faults?**
Fault between phase and ground; fault between phases and inter-turn fault involving turns of the same phase winding.

4. **What are the uses of Buchholz's relay?**
Bucholz relay is used to give an alarm in case of incipient (slow-developing) faults in the transformer and to connect the transformer from the supply in the event of severe internal faults. It is usually used in oil immersion transformers with a rating over 750KVA.

5. **What are the types of graded used in line of radial relay feeder?**
Definite time relay and inverse-definite time relay.

6. **What are the various faults that would affect an alternator?**
(a) Stator faults
1, Phase to phase faults
2, Phase to earth faults
3, Inter turn faults
(b) 1, Earth faults

2, Fault between turns
3, Loss of excitation due to fuel failure
(c) 1, Over speed
2, Loss of drive
3, Vacuum failure resulting in condenser pressure rise, resulting in
4. Shattering of the turbine low pressure casing
(d)1, Fault on lines
2, Fault on bus-bars

7. Why neutral resistor is added between neutral and earth of an alternator?
In order to limit the flow of current through neutral and earth a resistor is introduced between them.

8. What is the backup protection available for an alternator?
Over-current and earth fault protection is the backup protections.

9. What are faults associated with a transformer?
(a) External fault or through fault
(b) Internal fault
1, Short circuit in transformer winding and connection
2, Incipient or slow developing faults

10. What are the main safety devices available with transformer?
Oil level gauge, sudden pressure delay, oil temperature indicator, winding temperature indicator.

11. What are the limitations of Buchholz relay?
(a) Only fault below the oil level are detected.
(b) Mercury switch setting should be very accurate, otherwise even for vibration; there can be a false operation.
(c) The relay is of slow operating type, which is unsatisfactory.

12. What are the problems arising in differential protection in power transformer and how are they overcome?
1. Difference in lengths of pilot wires on either sides of the relay. This is overcome by connecting adjustable resistors to pilot wires to get equipotential points on the pilot wires.
2. Difference in CT ratio error difference at high values of short circuit currents that makes the relay to operate even for external or through faults. This is overcome by introducing bias coil.
3. Tap changing alters the ratio of voltage and currents between HV and LV sides and the relay will sense this and act. Bias coil will solve this.
4. Magnetizing inrush current appears wherever a transformer is energized on its primary side producing harmonics. No current will be seen by the secondary. CT's as there is no load in the circuit. This difference in current will actuate the differential relay. A harmonic restraining unit is added to the relay which will block it when the transformer is energized.

13. What is REF relay?
It is restricted earth fault relay. When the fault occurs very near to the neutral point of the transformer, the voltage available to drive the earth circuit is very small, which may not be sufficient to activate the relay, unless the relay is set for a very low current. Hence the zone of protection in the winding of the transformer is restricted to cover only around 85%. Hence the relay is called REF relay.

14. What is over fluxing protection in transformer?
If the turn's ratio of the transformer is more than 1:1, there will be higher core loss and the capability of the transformer to withstand this is limited to a few minutes only. This phenomenon is called over fluxing.

15. Why bus-bar protection is needed?
(a) Fault level at bus-bar is high
(b) The stability of the system is affected by the faults in the bus zone.

16. What are the merits of carrier current protection?

Fast operation, auto re-closing possible, easy discrimination of simultaneous faults.

17. What are the errors in CT?

(a) Ratio error

Percentage ratio error = [(Nominal ratio – Actual ratio)/Actual ratio] x 100

The value of transformation ratio is not equal to the turns ratio.

(b) Phase angle error:

Phase angle _ =180/_[(ImCos _-I1Sin _)/nIs]

18. What is field suppression?

When a fault occurs in an alternator winding even though the generator circuit breaker is tripped, the fault continues to fed because EMF is induced in the generator itself. Hence the field circuit breaker is opened and stored energy in the field winding is discharged through another resistor. This method is known as field suppression.

19. What are the causes of bus zone faults?

Failure of support insulator resulting in earth fault

Flashover across support insulator during over voltage

Heavily polluted insulator causing flashover

Earthquake, mechanical damage etc.

20. What are the problems in bus zone differential protection?

Large number of circuits, different current levels for different circuits for external faults.

Saturation of CT cores due to dc component and ac component in short circuit currents. The saturation introduces ratio error.

Sectionalizing of the bus makes circuit complicated.

Setting of relays need a change with large load changes.

21. How does the over voltage surge affect the power system?

The over voltage of the power system leads to insulation breakdown of the equipments. It causes the line insulation to flash over and may also damage the nearby transformer, generators and the other equipment connected to the line.

22. Mention any 2 applications of differential relays.

Protection of generator and generator-transformer unit: protection of large motors and bus bars

23. What is the general connection rule for Current transformers in differential protection?

If the windings of the power transformer are delta connected then the current transformers are star connected and if the windings of the power transformer are star connected then the current transformers are delta connected.

24. Write the coordination equation for inverse over-current relay?

$T_A=T_B+CB_B+O_A+F$

Where T_A operating time of relay at station A

T_B operating time of relay at station B

CB_B operating time of circuit breaker at station B

O_A over travel time of relay at station A

F factor of safety

25. What are the disadvantages of time graded protection?

1. Time lag not desirable on short circuits
2. Not suitable for ring mains
3. Difficult to coordinate & needs changes with new connection
4. Not suitable for long distance relaying

26. **Explain secondary of current transformer should not be open (nov/dec 2011)**
Results in excessive flux production and damage the insulation of the transformer

27. **What is meant by time graded system protection?**
To ensure selectivity of operation the operating time of the protection is increased from the far end of protected circuit towards the generating source.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION

1. **What is resistance switching?**
It is the method of connecting a resistance in parallel with the contact space(arc). The resistance reduces the restriking voltage frequency and it diverts part of the arc current. It assists the circuit breaker in interrupting the magnetizing current and capacity current.

2. **What do you mean by current chopping?**
When interrupting low inductive currents such as magnetizing currents of the transformer, shunt reactor, the rapid deionization of the contact space and blast effect may cause the current to be interrupted before the natural current zero. This phenomenon of interruption of the current before its natural zero is called current chopping.

3. **What are the methods of capacitive switching?**
Opening of single capacitor bank
Closing of one capacitor bank against another

4. **What is an arc?**
Arc is a phenomenon occurring when the two contacts of a circuit breaker separate under heavy load or fault or short circuit condition.

5. **Give the two methods of arc interruption?**
High resistance interruption:-the arc resistance is increased by elongating, and splitting the arc so that the arc is fully extinguished Current zero method:-The arc is interrupted at current zero position that occurs100 times a second in case of 50Hz power system frequency in ac.

6. **What is restriking voltage? (nov/dec 2011)**
It is the transient voltage appearing across the breaker contacts at the instant of arc being extinguished.

7. **What is meant by recovery voltage? (nov/dec 2011)**
The power frequency rms voltage appearing across the breaker contacts after the arc is extinguished and transient oscillations die out is called recovery voltage.

8. **What is RRRV?**
It is the rate of rise of restriking voltage, expressed in volts per microsecond. It is closely associated with natural frequency of oscillation.

9. **What is circuit breaker?**
It is a piece of equipment used to break a circuit automatically under fault conditions. It breaks a circuit either manually or by remote control under normal conditions and under fault conditions.

10. **What is the main problem of the circuit breaker?**
When the contacts of the breaker are separated, an arc is struck between them. This arc delays the current interruption process and also generates enormous heat which may cause damage to the system or to the breaker itself. This is the main problem.

11. Mention the details circuit breaker rating

Rated voltage & rated current
Rated Frequency
Rated breaking capacity, symmetrical & asymmetrical
Rated making capacity
Rated short time current
Rated operating duty

12. **What are the factors the ARC phenomenon depends upon**?

The nature and pressure of the medium
The external ionizing and de-ionizing agent present
Voltage across the electrodes and its variation with time
The nature shape & separation of electrodes
The nature and shape of vessel and its position in relation to the electrodes

13. What are the factors the arc resistance depends upon?

Degree of ionization
Length of the arc
Cross section area of the arc

14. What is breaking current?

The breaking current of a circuit breaker of a circuit breaker is the current in that pole at the instant of contact separation.

15. What is symmetrical breaking current?

R.M.S Value of the A.C component of the current in the pole at the instant of contact separation

16. What is asymmetrical breaking current?

R.M.S Value of the A.C & D.C component of the current in the pole at the instant of contact separation

17. What are breaking capacities?

The symmetrical value of breaking capacity is the value of the symmetrical breaking current which the circuit breaker is capable of breaking at the stated recovery voltage and restriking voltage under prescribed condition

18. What are the factors the recovery voltage depends upon? (nov/dec 2011)

Power factor, Armature reaction & Circuit condition

19. What is rated making current?

The making current a circuit breaker when closed on a short circuit is the RMS value of the total current which is measured from the envelope of the current wave at the time of its first major peak.

20. What is the basic requirement of DC circuit breaking?

Lengthening of the arc is basic requirements of D.C circuit breaker. Loss of energy increases with increasing length of arc and more power will be required to maintain the arc.

21. What are the problems associated with DC circuit breakers?

Natural current zero does not occur as in the case of A.C circuit breakers
The amount of energy to be dissipated during the short interval of breaking is very high as compared to conventional A.C circuit breakers.

22. What is the purpose of protective spark gap?

A protective spark gap can be used across the circuit breaker to reduce the size of commutation capacitor. The spark gap acts as an energy dissipating device for high frequency currents

23. What is the purpose of arc chute?

By breaking the arcs into number of smaller arcs and by increasing the space between two walls of arc chute the deionization of the arc can be increased

24. What are the factors RRRV depends upon?

Active recovery voltage & Natural frequency of oscillation

25. Differentiate between the static and dynamic characteristics of the arc?

If the current changes rapidly with time the characteristics are known as dynamic characteristics. If the rate of change of current is small the characteristics are known as static characteristics.

UNIT V CIRCUIT BREAKERS

1. What is dielectric test of a circuit breaker?

It consists of over voltage withstand test of power frequency lightning and impulse voltages. Tests are done for both internal and external insulation with switch in both open and closed conditions.

2. How direct tests are conducted in circuit breakers?

Using a short circuit generator as the source.
Using the power utility system or network as the source.

3. Define composite testing of a circuit breaker.

In this method the breaker is first tested for its rated breaking capacity at a reduced voltage and afterwards for rated voltage at a low current. This method does not give a proper estimate of the breaker performance.

4. State the disadvantages of field tests.

The circuit breaker can be tested at only a given rated voltage and network capacity. The necessity to interrupt the normal services and to test only at light load conditions. Extra inconvenience and expenses in installation of controlling and measuring equipment in the field.

5. Mention the advantages of field tests.

The circuit breaker is tested under actual conditions like those that occur in the network. Special occasions like breaking of charging currents of long lines ,very short line faults ,interruption of small inductive currents etc… can be tested by direct testing only.

6. Mention the various tests carried out in a circuit breaker at HV labs.

Short circuit tests, Synthetic tests& direct tests.

7. What are the advantages of synthetic testing methods?

- The breaker can be tested for desired transient recovery voltage and RRRV.
- Both test current and test voltage can be independently varied. This gives flexibility to the test
- The method is simple
- With this method a breaker capacity (MVA) of five time of that of the capacity of the test plant can be tested.

8. What are the indirect methods of circuit breaker testing?

- Unit test
- Synthetic test
- Substitution testing
- Compensation testing
- Capacitance testing

9. **Write the classifications of test conducted on circuit breakers.**
    - Type test
    - Routine test
    - Reliability test
    - Commissioning test

10. **What are the characteristic of SF6 gas?**
    It has good dielectric strength and excellent arc quenching property. It is inert, non-toxic, noninflammable and heavy. At atmospheric pressure, its dielectric strength is 2.5 times that of air. At three times atmospheric pressure, its dielectric strength is equal to that of the transformer oil.

11. **Give the advantage of SF6 circuit breaker over air blast circuit breaker (nov/dec 2011)**
    High electro negativity, compactness, reduced switching over voltages, reduced insulation time, superior arc interruption and increased safety

12. **What is meant by electro negativity of SF6 gas?**
    SF6 has high affinity for electrons. When a free electron comes and collides with a neutral gas molecule, the electron is absorbed by the neutral gas molecule and negative ion is formed. This is called as electro negativity of SF6 gas.

13. **What are the demerits of using oil as an arc quenching medium?**
    The air has relatively inferior arc quenching properties
    The air blast circuit breakers are very sensitive to variations in the rate of rise of restriking voltage
    Maintenance is required for the compression plant which supplies the air blast

14. **What are the advantages of air blast circuit breaker over oil circuit breaker?**
    The risk of fire is diminished
    The arcing time is very small due to rapid buildup of dielectric strength between contacts
    The arcing products are completely removed by the blast whereas oil deteriorates with successive operations

15. **What are the types of air blast circuit breaker?**
    Arial-blast type
    Cross blast
    Radial-blast

16. **What are the disadvantages of MOCB over a bulk oil circuit breaker?**
    The degree of carbonization is increased due to smaller quantity of oil
    There is difficulty of removing the gases from the contact space in time
    The dielectric strength of the oil deteriorates rapidly due to high degree of carbonization.

17. **What are the advantages of MOCB over a bulk oil circuit breaker?**
    It requires lesser quantity of oil
    It requires smaller space
    There is a reduced risk of fire
    Maintenance problem are reduced

18. **What are the hazards imposed by oil when it is used as an arc quenching medium?**
    There is a risk of fire since it is inflammable. It may form an explosive mixture with arc. So oil is preferred as an arc quenching medium

19. **What are the advantages of oil as arc quenching medium?**
    It absorbs the arc energy to decompose the oil into gases, which have excellent cooling properties
    It acts as an insulator and permits smaller clearance between line conductors and earthed components

20. What are demerits of MOCB?

Short contact life
Frequent maintenance
Possibility of explosion
Larger arcing time for small currents
Prone to restricts

21. Write the classification of circuit breakers based on the medium used for arc extinction?

Air break circuit breaker
Oil circuit breaker
Minimum oil circuit breaker
Air blast circuit breaker
SF6 circuit breaker
Vacuum circuit breaker

22. What are the different types of oil circuit breakers?

Plain break oil circuit breakers
Arc control circuit breakers
Minimum oil circuit breakers

23. What are different types of arc control pots?

Axial blast, cross blast and combination of both

24. What are the advantages of using vacuum as an arc interrupting medium?

High insulation strength and interruption occurs in the first current zero

25. What are the ways in which electrons can be emitted in vacuum?

Thermionic emission, Field emission, Thermionic & field emission, secondary emission by photons, pinch effect emission

26. Write any two properties of contact material used in vacuum circuit breaker?

Good electrical conductivity to pass normal load currents without over heating.
Good thermal conductivity to dissipate rapidly the large heat generated during arcing

27. What are the basic requirements of circuit breaker? (nov/dec 2011)

To make or break a circuit either manually or by remote control under normal conditions
Break a circuit automatically under fault condition
Make a circuit automatically either manually or by remote control after the fault is cleared

16 MARK QUESTIONS

PART-B

UNIT I - PROTECTION SCHEMES

1. Describe in detail the principles of protective system.
2. Explain details about basic requirements of protective relays.
3. What are the functions of protective relays? Narrate about Nature and Causes of faults.
4. What are the types of faults? Explain in detail about symmetrical and unsymmetrical faults.
5. Clearly describe about fault current calculation using symmetrical components.
6. Explain different zones of protection.
7. What is the concept of back up relays? Explain the methods of back up protection.
8. Define and write the need for power system earthing?
9. What are the drawbacks of ungrounded system? Mention the advantages of neutral grounding.
10. Briefly explain about

    (1).Resistance earthing.

    (2).Resonant grounding.

    (3).Reactance earthing

UNIT II ELECTROMAGNETIC RELAYS

1. What are the different types of electromagnetic relays? Discuss their field of applications. (16)

2. What are the various types of over current relays? Discuss their area of application. (16)

3. Describe the operating principle, constructional features and area of applications of reverse power or directional relay. (16)

4. Describe the construction and principle of operation of an induction type directional over current relay. (16)

5. Explain the working principle of distance relays. (16)

6. Write a detailed note on differential relays. (16)

7. Describe the realization of a directional over current relay using a microprocessor. (16)

8. Derive a generalized mathematical model of di
stance relays for digital protection. (16)

9. (a) How can digital distance relaying algorithm be implemented on the 8086 Micro processor?(8)

(b) It is possible to implement these algorithms on the 8085micro processor? (8)

10. Explain with sketches andtheir R-X diagrams for the following distance relays.

(i) Impedance relay (5)

(ii) Mho relay (5)

(iii) Reactance relay (6)

11. (a) Explain the applications of microprocessors in power system protection. (8)

(b) Explain microprocessor based inverse time over current relay. (8)

UNIT III APPARATUS PROTECTION

1. Enumerate the relaying schemes which are employed for the protection of a modern alternator. (16)

2. (a) What is transverse or split phase protection of an alternator? (4)

(b) What type of fault is this scheme of protection employed? (4)

(c) With a neat sketch discuss the working principle of this scheme. (8)

3. What type of a protective device is used for the protection of an alternator against overheating of its (i) stator (ii) rotor? Discuss them in brief. (8+8)

4. What type of a protective scheme is employed for the protection of the field winding of the alternator against ground faults? (16)

5. Discuss the protection employed against loss of excitation of an alternator. (16)

6. (a) What do you understand by field suppression of an alternator? (8)

(b) How is it achieved? (8)

7. Briefly discuss the protection of an alternator against.

(i) Vibration of distortion of motor (4)

(ii) Bearing overheating (4)

(iii) Auxiliary failure (4)

(iv) Voltage regulator failure (4)

8. What type of pilot protection is used for EHV and UHV transmission lines. (16)

9. (a) What is carrier protection? (4)

(b) For what voltage range is it used for the protection of transmission line? (4)

(c) What are its merits and demerits? (8)

10. (a) What is carrier aided distance protection. (4)

(b) What are its different types? (4)

(c) Discuss the permissive under each transfer tripping scheme of protection. (8)

11. (a) Draw and explain the merz price protection of alternator stator winding. (10)

UNIT IV - STATIC RELAYS AND NUMERICAL PROTECTION

1. Describe with a neat block diagram and explain of STATIC relays
2. Explain the following terms in detail:
   (i) Merits and Demerits of static Relay.
   (ii) Phase Comparator.
3. Explain the following terms in detail:
   Amplitude comparator
   Synthesis of various relays using Static comparators
4. Describe with a neat diagram of transformer differential protection for the numerical relay
5. Describe with a neat diagram of Over Current protection for the numerical relay
6. Describe with a neat diagram of Distance protection for the numerical relay
7. Describe with a neat diagram of Distance transmission LINES protection for the numerical relay
8. Explain the characteristics of numerical relay?
9. With block diagram explain the functionality of digital relays with its merits.
10. Explain about fault diagnosis algorithm development stages.

UNIT V CIRCUIT BREAKERS

1. (a) What is resistance switching? (4)
   (b) Derive the expression for critical resistance. (12)
2. (a) Explain the phenomenon of current chopping in a circuit breaker. (12)
   (b) What measures are taken to reduce it? (4)
3. Discuss the problem associated with the interruption of
   (i) Low inductive current (5)
   (ii) Capacitive current and (5)
   (iii) Fault current if the fault is very near the substation. (6)
4. Explain in detail about RRRV. (16)
5. Discuss the recovery rate theory and energy balance theory of arc interruption in a circuit breaker. (16)
6. Explain terms:
   i) Re striking voltage (3)
   ii) Recovery voltage (3)
   iii) RRRV (3)

iv) Derive expressions for re striking voltage and RRRV. (3)

v) What measures are taken to reduce them? (4)

7. With neat sketch, describe the working principle of an axial air blast type circuit breaker. (16)

8. (a) Discuss the operating principle of SF6 circuit breaker. (10)

(b) What are its advantages over other types of circuit breakers? (3)

(c) For what voltage range is it recommended? (3)

9. Describe construction, operating principle and application of vacuum circuit breaker. For what voltage range is it recommended? (16)

10. (a) What are the various types of operating mechanisms which are used for opening and closing of the contacts of a circuit breaker? (10)

(b)Discuss their merits and demerits. (6)

11. (a) Enumerate various types of ratings of a circuit breaker. (4)

EE6703 - SPECIAL ELECTRICAL MACHINES

TWO MARKS QUESTIONS & ANSWERS

UNIT-I - SYNCHRONOUS RELUCTANCE MOTOR

1. What is synchronous reluctance motor?

- A reluctance motor is a type of synchronous electric motor which induces non-permanent magnetic poles on the ferromagnetic rotor. Torque is generated through the phenomenon of magnetic reluctance.
- The stator consists of multiple salient (ie. projecting) electromagnet poles, similar to a wound field brushed DC motor. The rotor consists of soft magnetic material, such as laminated silicon steel, which has multiple projections acting as salient magnetic poles through magnetic reluctance.

- The number of rotor poles is typically less than the number of stator poles, which minimizes torque ripple and prevents the poles from all aligning simultaneously -- a position which can not generate torque.

2. **Define the characteristics of synchronous reluctance motor**.

The synchronous reluctance motor is not self starting without the squirrel cage. During run up it behaves as an induction motor but as it approaches synchronous speed, the reluctance torque takes over and the motor locks into synchronous speed.

3. Write the applications of syrm.

Used where regulated speed control is required in applications suc as metering pumps and industrial process equipment.

4. What is the classification of syrm?

- Axially laminated
- Radially laminated

5. **What are the primary design consideration of syrm**?

- High o/p power capability
- Ability of the rotor to withstand high speed.
- High reliability
- Low cost
- High efficiency

6. Define power factor of syrm

PF max=(Ld/Lq-1)/(Ld/Lq+1)

Higher Ld/Lq ratos yield higher power factors,which corresponds to reduced I^2R losses and reduce volt ampere ratings of the inverter driving the machine.

7. What are the applications of the torque – speed characteristics of syrm?

- Comparable power density but better efficiency than induction motor
- Slightly lower power factor
- Sensorless control is much easier due to motor saliency.

8. What are advantages of syrm over pm machine?

- More reliable than PM machine
- There need not be any excitation field as torque is zero,thus eleiminating electro magnetic spinning losses.

9. What are applications of syrm?

- Synthetic fiber manufacturing equipment
- Wrapping and folding machine
- Auxiliary time mechanism
- Synchronized conveyors
- Metering pumps

10. What is vernier motor?

It is an unexcited reluctance type sync.motor.the peculiar feature of this motor is that a small displacement of the rotor produces a large displacement of the axis of maximum and minimum permeance.

11. What are the advantages of syrm ?

- Freedom from pm
- Ability to maintain full load torque at zero speed
- A wide speed range at constant power.

12. What are the classifications of SYRM?

- Rotor configuration

i) cage rotor for line start
ii) cageless-rotors for variable speed

- Stator windings
- Stator current controlled mode

13. What are the rotor configurations of SYRM?

Rotor configuration
i)cage rotor for line start
ii)cageless-rotors for variable speed

14. What is meant by Slow-speed synchronous timing motors?

Representative are low-torque synchronous motors with a multi-pole hollow cylindrical magnet (internal poles) surrounding the stator structure. An aluminum cup supports the magnet. The stator has one coil, coaxial with the shaft. At each end of the coil are a pair of circular plates with rectangular teeth on their edges, formed so they are parallel with the shaft. They are the stator poles. One of the pair of discs distributes the coil's flux directly, while the other receives flux that has passed through a common shading coil. The poles are rather narrow, and between the poles leading from one end of the coil are an identical set leading from the other end. In all, this creates a repeating sequence of four poles, unshaded alternating with shaded, that creates a circumferential traveling field to which the rotor's magnetic poles rapidly synchronize. Some stepping motors have a similar structure.

15. What is meant by Watthour-meter motors?

These are essentially two-phase induction motors with permanent magnets that retard rotor speed, so their speed is quite accurately proportional to wattage of the power passing through the meter. The rotor is an aluminum-alloy disc, and currents induced into it react with the field from the stator. One phase of the stator is a coil with many turns and a high inductance, which causes its magnetic field to lag almost 90 degrees with respect to the applied (line/mains) voltage. The other phase of the stator is a pair of coils with very few turns of heavy-gauge wire, hence quite-low inductance. These coils are in series with the load.

16. How does the Watthour-meter motors look like?

The core structure, seen face-on, is akin to a cartoon mouth with one tooth above and two below. Surrounding the poles ("teeth") is the common flux return path. The upper pole (high-inductance winding) is centered, and the lower ones equidistant. Because the lower coils are wound in opposition, the three poles cooperate to create a "sidewise" traveling flux. The disc is between the upper and lower poles, but with its shaft definitely in front of the field, so the tangential flux movement makes it rotate.

17. Electronically commutated motors?

Such motors have an external rotor with a cup-shaped housing and a radially magnetized permanent magnet connected in the cup-shaped housing. An interior stator is positioned in the cup-shaped housing. The interior stator has a laminated core having grooves. Windings are provided within the grooves. The windings have first end turns proximal to a bottom of the cup-shaped housing and second end turns positioned distal to the bottom. The first and second end turns electrically connect the windings to one another. The permanent magnet has an end face rom the bottom of the cup-shaped housing. At least one galvano-magnetic rotor position sensor is arranged opposite the end face of the permanent magnet so as to be located within a magnetic leakage of the permanent magnet and within a magnetic leakage of the interior stator. The at least one rotor position sensor is designed to control current within at least a portion of the windings. A magnetic leakage flux concentrator is arranged at the interior stator at the second end turns at a side of the second end turns facing away from the laminated core and positioned at least within an angular area of the interior stator in which the at least one rotor position sensor is located

18. What is meant by repulsion motor?

Repulsion motors are wound-rotor single-phase AC motors that are similar to universal motors. In a repulsion motor, the armature brushes are shorted together rather than connected in series with the field. By transformer action ,the stator induces currents in the rotor, which create torque by repulsion instead of attraction as in other motors. Several types of repulsion motors have been manufactured, but the *repulsion-start induction-run* (RS-IR) motor has been used most frequently. The RS-IR motor has a centrifugal switch that shorts all segments of the commutator so that the motor operates as an induction motor once it has been accelerated to full speed. Some of these motors also lift the brushes out of contact with the commutator once the commutator is shorted. RS-IR motors have been used to provide high starting torque per ampere under conditions of cold operating temperatures and poor source voltage regulation

19. Define Slip.

If the rotor of a squirrel runs at high speed, the flux in the rotor at any given place on the rotor would not change, and no current would be created in the squirrel cage. For this reason, ordinary squirrel-cage motors run at some tens of rpm slower than synchronous speed, even at no load. Because the rotating field (or equivalent pulsating field) actually or effectively rotates faster than the rotor, it could be said to slip past the surface of the rotor. The difference between synchronous speed and actual speed is called slip, and loading the motor increases the amount of slip as the motor slows down slightly.

20. Write the formula for the speed of the AC motor.

The speed of the AC motor is determined primarily by the frequency of the AC supply and the number of poles in the stator winding, according to the relation:

$$N_s = 120F / p$$

Where

N_s = Synchronous speed, in revolutions per minute F = AC power frequency

p = Number of poles per phase winding

UNIT – II - STEPPER MOTORS

1. What is stepper motor?

A stepper motor is a digital actuator whose input is in the form of programmed energization of the stator windings and whose output is in the form of discrete angular rotation.

2. Define step angle.

Step angle is definrd as the angle through which the motor rotates for each command pulse.it is denoted as β.
β=(Ns-Nr/Ns.Nr)360 (or)360/(mNr)

3. Define slewing

The stepper motor operates at very high speed is called slew angle.i,e (25000 steps per sec).

4. Define resolution

It is defined as the no.of steps needed to complete one revolution of the shaft. Resolution = no . of steps /revolution

5. Mention some applications of stepper motor

i. floppy disc drives
ii. qurtz watch
iii. camera shutter operation
iv. dot matrix and line printers
v. small tool application
vi. robotics

6. What are the advantages and disadvantages of stepper motor?

Adv:

- it can be driven in open loop without feedback
- it is mechanically simple
- it requires little or no maintenance.

Disadv:

- low efficiency
- fixed step angle
- limited power output

7. Define holding torque.

Holding torque is the maximum load torque which the energized stepper motor can withstand without slipping from equilibrium position

8. Define detent torque

Detent torque is the maximum torque which the unenergised stepper motor can withstand without slipping.it is also known as cogging torque.

9. What is meant by full step operation?

Full step operation or single phase on mode is the one in which at a time only one phase winding is energized, due to which one stator winding is energized and causes the rotor to rotate some angle.

10. What is meant by two phase mode of operation?

wo phase on mode is the one in which two phase windings are energized at a time, due to which two stator windings are energized and causes the rotor to rotate through some angle.

11. Define pull in torque.

It is the maximum torque the stepper motor can develop in start – stop mode at a given stepping rate Fs (step/sec) without losing synchronism.

12. Define pull out torque.

It is the maximum torque the stepper motor can develop in slewing mode at a given stepping rate Fs (step/sec) without losing synchronism.

13. What is synchronism in stepper motor?

It is the one to one correspondence between the number the number of pulses applied to the stepper motor and the number of steps through which the motor has actually moved.

14. Define mid frequency resonance in stepper motor.

The phenomenon at which the motor torque drops to a low value at certain input pulse frequencies.

15. Define static stiffness.

It is a measure of ability of the actuator to resist disturbing torques and forces and thereby to maintain position.it is defined as

S=torque / rad

16. Give the types of driver circuits.

- Resistance or L/R drive
- Dual voltage or bilevel drive
- Chopper drive

17. What is multi stack VR motor

Multi stack VR motor is the one in which the stepper motor has three separate magnetically nisolated sections or stacks.here the rotor and stator teeths are equal.

18. What is meant by micro stepping in stepper motor.

The methods of modulating currents through stator windings so as to obtain rotation of stator magnetic field through a small angle to obtain micro stepping action is known as micro stepping.

19. What are the advantages of micro stepping?

- Improvement in resolution.
- Dc motor like performance
- Elimination of mid frequency resonance
- Rapid motion at micro stepping rate.

20. Define bandwidth in stepper motor.

It is a measure of the frequencies up to which the actuator or servo motor system can respond.

UNIT-III - SWITCHED RELUCTANCE MOTOR

1. What is srm?

It is a doubly salient , single excited motor.this means that it has salient poles on both rotor and the stator.but only one member carries winding.the rotor has no windings,magnets or case windings.

2. What are the advantages od SRM?

- Construction is very simple
- Rotor carries no winding
- No brushes and requires less maintenance

3. What are the disadvantages of SRM?

- It requires a position sensor
- Stator phase winding shold be capable of carrying magnetizing currents

4. Why rotor position sensor is essential for the operation of switched reluctance motor?

It is necessary to use a rotor position sensor for commutation and speed feedback. The turning on and off operation of the various devices of power semiconductor switching circuit are influenced by signals obtained from rotor position sensor.

5. What are the different power controllers used for the control of SRM?

- Using two power semi conductors and two diodes per phase
- Phase windings and bifilar wires
- Dump – C converter
- Split power supply converter

6. What are the applications of SRM?

- Washing machines
- Fans
- Robotic control applications
- Vacuum cleaner
- Future auto mobile applications

7. What are the two types of current control techniques?

- Hysteresis type control
- PWM type control

8. What is meant by energy ratio?

Energy ratio = Wm/(Wm+R)=0.45 Wm=mechanical energy transformed

This energy cannot be called as efficiency. As the stored energy R is not wasted as a loss but it is feedback to the source through feedback diodes.

9. Write the torque equation of SRM?

T=1/2(i^2 dL/dθ)

10. What is phae winding?

Stator poles carrying field coils.the field coils of opposite poles are connected in series such that mmf „s are additive and they are called „"phase winding"" of SRM.

11. Write the characteristics of SRM.

- Lowest construction complexity, many stamped metal elements
- Like a BLDC or stepper without the magnets
- High reliability (no brush wear), failsafe for Inverter but...acoustically noisy
- High efficiency

12. Define the control system of SRM.

The control system is responsible for giving the required sequential pulses to the power circuitry in order to activate the phases as required. There are two options for producing the sequence including a microcontroller to produce the signal or a timer circuit which could also produce the desired signal

13. Define the timer circuit of SRM.

The use of a timer circuit would be very effective in producing the necessary signal in which to control the circuit. As the required signal is very simple it could easily be implemented by digital timer, such as the 555 timer. A digital timer is more precise than any other form of timer, such as a mechanical timer. With the widespread use of digital logic within integrated circuits the cost of these timers has reduced considerably. The latest controllers in use incorporate programmable logic controllers (PLC"s) rather than electromechanical components in its implementation. Within PLC"s, the timers are normally simulated by the software incorporated in the controller; the timer is therefore controlled by the software. There are obvious advantages to this system, although the control of a soft start could be hard to implement in this way.

14. Write the soft starters of SRM.

Mechanical – come in the form of torque limiters utilizing clutches and various couplings,

Electrical – these soft starters alter the power supply to the motor to reducing the torque and current demand. This is normally performed either by reducing the supply voltage, or controlling the frequency of excitation. Since switched reluctance motors are driven by a controlled pulsed supply, frequency control is an obvious choice in this case.

15. What are the goals to contro, soft starting?

Fixed start-up time - the start up will be controlled to achieve full speed within a fixed time

Current limit - the motor current can be monitored and the start up controlled to keep it below a specified limit

Torque limit - an intelligent starter can calculate the motor torque based on the current and voltage demand and control the start up to provide a constant starting torque

16. What are the major advantages of frequency control of SRM?

This has a major advantage of being easily controlled and changed at any point by simply altering the programming. By using this method the development time is reduced and the number of modules to implement is also reduced.

18. Define the isolation of SRM.

The electrical isolation of the control and power circuitry modules is very important and is used so that the control electronics are protected from any voltage fluctuations in the power circuitry. The major method of isolation used today are optoisolators, these isolators use short optical transmission paths to transfer a signal from one part of a circuit to another. The isolator incorporates a transmitter and a receiver, the signal therefore converts from electrical to optical before converting back to electrical thereby breaking any electrical connection between input and output.

19. Define the power circuitry of SRM.

- The most common approach to the powering of a switched reluctance motor is to use an asymmetric bridge converter.
- There are 3 phases in this in an asymmetric bridge converter corresponding to the phases of the switched reluctance motor. If both of the power switches either side of the phase are turned on, then that corresponding phase shall be actuated. Once the current has risen above the set value, the switch shall turn off. The energy now stored within the motor winding shall now maintain the current in the same direction until that energy is depleted.
- N+1 Switch And Diode
- This basic circuitry may be altered so that fewer components are required although the circuit shall perform the same action. This efficient circuit is known as the (n+1) switch and diode configuration.
- A capacitor can be added to either configuration, and is used to address noise issues by ensuring that the switching of the power switches shall not cause fluctuations in the supply voltage.

20. What are the current control schemes?

- Hysteresis type current regulator
- PWM type current regulator

UNIT IV – PERMANENT MAGNETS AND BRUSHLESS DC MOTORS

1. what are the advantages of brushless dc motors drives?

- Regenerative braking is possible
- Speed can be easily controllable

2. what are the disadvantages of brushless dc motors drives?

- It requires a rotor position sensor
- It requires a power semiconductor switching circuits.

3. **Define mechanical commutators?**

- Its arrangement is located in the rotor

- No of commutators segments are very high .

4.**Define electronic commutators?**

- Its arrangement is located in the stator
- No of switching devices limited to six

5.Mention some applications of PMBL DC motor?

- Power alternators
- Automotive applications
- Computer and Robotics applications
- Textile and Glass industries

6.what are conventional Dc motor?

- Field magents on the stator
- Maintenance is high

7.what are PMBL DC motor?

- Field magents on the rotor
- Low maintanace

8.why is the PMBLDC motor called electronically commutated motor?

The PMBL DC motor is also called electronically commutated motor because the phase windings of PLMBL DC motor is energized by using power semiconductor switching circuits. here the power semiconductor switching circuits act as a commutator.

9. What are the classification of BLPM DC motor?

- BLPM square wave motor
- BLPM sine wave motor

10.What are the two types of BLPM SQW DC motor?

- 180”polerarc BLPM SQW motor
- 120”polearc BLPM SQW motor

11.What are the two types of rotor position sensors?

- Optical position sensor
- Hall effect position sensor

12.what are the materials used for making Hall IC pallet?

- Indiem-antinomy
- Gallium-arsenide

13.what are applications of stator?

- Automotive applications
- Veticular electric drive motors

14.what are the classification of BLPM dc motor?

- One phase winding and one pulse BLPM dc motor
- One phase winding and two pulse BLPM dc motor
- Two phase winding and two pulse BLPM dc motor
- Three phase winding and three pulse BLPM dc motor
- Three phase windings and six pulse circuits

15.what are the features of one phase winding and one pulse BLPM dc motor?

- It is inertia should be high,such that rotor rotates continuously
- Utilization of transistor and windings are less

16.what are the features of one phase winding and two pulse BLPM dc motor?

- In this case winding utilization is better,however transistor utilization is less.
- Torque developed is more uniform

17.what are the features of two phase winding and two pulse BLPM dc motor?

- Winding utilization is only 50%which is less
- It provide better torque waveforms

18.what are the features of three phase windings and 6 pluse circuits?

- Utilization factor of winding will be better
- Torque pulse and ripple frequency components are less

21.what is meant by self control?

Self control ensures that for all opearating points the armature and rotor fields move exactly at the same speed.

22.what is meant by vector control?

PMSm are employed for variable speed applications. The process of controlling voltage and frequency to get the desired speed and torque is known as vector control of PMSM

UNIT –V PERMANENT MAGNETS AND SYNCHRONOUS MOTORS

1.Define stator?

Stator is made up of silicon steel stampings.stator slots carry a balanced 3phase armature winding, wound for a specified even number of poles.The ends of the armature windings are connected to the terminals of the motor.

2.Define rotor?

Rotor is made up of forged steel with outward projected poles.The number of rotor poles must be same as that of stator.These rotor poles carry field coils.They aare suitably connected to form a field winding.The ends of the field windings are connected to the two slip rings which are also mounted on to the same shaft.

3.what are merits of 3phase BLPM synchronous motor?

- It runs at a constant speed.
- No sliding contacts so it requires less maintenance.

4.what are the demerits of 3 phase BLMP synchronous motor?

Power factor of operation cannot be controlled as field current can‟t be controlled.

5.what are the rotor configurations?

- Peripheral
- Interior
- Claw-pole or Lundell

6. what are the advantages of load commutation?

- It does not require commutation circuits
- Frequency of operation can be Transverse higher

7. what are the applications of load commutation?

Some prominent applications of this drive are high speed and high power drives for compressors,blowers,conveyers,steelrolling.

8. what are advantages of synchronous motor?

- Four quadrant operation with regenerative braking is possible
- High power ratings(up to 100MW)and run at high speeds(6000rpm)

9. what are the applications of synchronous drive?

- High speed and high power drives for compressors,blowers,fans,pumps,aircraft test facilities.

10.what are the features of permanent magnet synchronous motor?

- Robust, compact and less weight
- High efficiency

11. what are the advantages of load commutation?

- It does not require commutation circuits
- Frequency of operation can be higher

12. what are the applications of PMSM?

- Used as a direct drive traction motor
- Used as high speed and high power drives for compressors,blowers,conveyors

13.what are features of closed-loop speed control of load commutated inverter fed synchronous motor drive?

- High efficiency
- Four auadrant operation with regeneration braking is possible

14. what are the merits of PMSM?

- It runs at constant speed
- No field winding,no field loss,better efficiency

15.what are the demerits of PMSM?

Power factor of operation cannot be controlled as field winding cannot be controlled It leads to losses and decreases efficiency

16.what are assumptions made in derivation of emf equation for PMSM?

- Flux density distribution in the air gap is sinusoidal
- Armature winding consists of full pitched, concentrated similarly located coils of equal number of turns

17. Why PMSM operating in self controlled mode is known commutatorless dc motor?

Load side controller performs some what similar function as commutator in a dc machine.The load side converter and synchronous motor combination function similar to a dc machine.

First,it is fed from a dc supply and secondly like a dc machine. The stator and rotor field remain stationary with respect to each other at all speeds.Consequently,the drive consisting of load side converter and synchronous motor is known as “Commutator less dc motor”.

18.what is”pulsed mode”?

For speeds below 10%of base speed,the commutation of load side converter thyristors Is done by forcing the current through the conducting thyristors to zero

This is realized by making source side converter to work as inverter each time load side converter thyristors are to be turned off Since the frequency of operating of load side converter is very low compared to the source frequency.Such an operation can be realized.The operation of inverter is termed as”Pulsed mode”

19. What is load commutation?

Commutation of thyristors by induced voltages of load is known as"Load commutation".Here,frequency of operation is higher and it does not require commutation circuits.

20. What is meant bysynchronous reactance?

It is the sum of armature leakage reactance and fictitious reactance.

Xs=Xt+Xa

16 MARKS

PART-B

UNIT-I - SYNCHRONOUS RELUCTANCE MOTOR

1. Explain the constructions and working principle of synchronous reluctance motor. (16)

2. Explain in detail about classification of synchronous reluctance motor. (16)
3. Draw the phasor diagram of synchronous reluctance motor. (16)

4. Derive the torque equation of synchronous reluctance motor. (16)

5. Draw and explain the characteristics of synchronous reluctance motor. (16)

6. Explain in detail about vernier motor. (16)

UNIT – II - STEPPER MOTORS

1. Explain the construction and various modes of excitation of VR stepper motor. (16)

2. Explain the construction and various modes of excitation of PM stepper motor. (16)

3. Explain the construction and working principle of Hybrid Stepper motor. (16)

4. State and explain the static and dynamic characteristics of a stepper motor. (16)

5. Explain in detail about different types of power drive circuits for stepper motor. (16)

6. Explain the mechanism of torque production in VR stepper motor. (16)

7. Draw any two drive circuits for stepper motor. (16)

UNIT-III - SWITCHED RELUCTANCE MOTOR

1. Explain the construction and working principle of switched reluctance motor. (16)

2. Describe the various power controller circuits applicable to switched reluctance motor and explain the operation of any one scheme with suitable circuit diagram. (16)

3. Draw a schematic diagram and explain the operation of a „C" dump converter used for the control of SRM. (16)

4. Derive the torque equation of SRM. (16)

5. Draw and explain the general torque-speed characteristics of SRM and discuss the type of control strategy used for different regions of the curve. Sketch the typical phase current waveforms of low speed operation. (16)

6. Describe the hysterisis type and PWM type current regulator for one phase of a SRM. (16)

UNIT IV – PERMANENT MAGNETS AND BRUSHLESS DC MOTORS

1. Sketch the structure of controller for PMBLDC motor and explain the functions of various blocks. (16)

2. Explain the closed loop control scheme of a permanent magnet brushless dc motor drive with a suitable schematic diagram. (16)

3. Drive the expressions for the emf and torque of a PMBLDC motor. (16)

4. Draw the diagram of electronic Commutator. Explain the operation of electronic Commutator. (16)

5. Discuss the use of Hall sensors for position sensing in PMBLDC motor. (16)

6. Sketch the torque-speed characteristics of a PMBLDC motor. (16)

UNIT –V PERMANENT MAGNETS AND SYNCHRONOUS MOTORS

1. Explain the construction and operation of PMSM. (16)

2. Explain the principle of operation of a sine wave PM synchronous machine in detail. Draw its phasor diagram and derive its torque equation. (16)

3. Derive the emf equation of PMSM. (16)
4. Write about Self control of PMSM. (16)

5. Derive the expressions for power input and torque of a PMSM. Explain how its torque speed characteristics are obtained. (16)

6. Explain in detail the vector control of permanent magnet synchronous motor. (16)

MG6851 - PRINCIPLES OF MANAGEMENT

TWO MARK QUESTIONS AND ANSWERS

UNIT-I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

1. What is Management?
   Management is the process of giving direction and controlling the various activities of the people to achieve the objectives of an organization.

2. Define – Management.
   According to koontz & Weihrich "management is the process of designing and maintaining of an environment in which individuals working together in group efficiently accomplished selected aims".
   - Write some characteristics of Management.
   - Management is a continuous process.
   - Managers use the resources of the organization both physical as well as human to achieve the goals.
   - Management aims at achieving the organization goals by ensuring effective use of resources.

3. What are the roles of management in organization?
   - Managements help in determination of the objectives of an organization.
   - Economics and social development takes place through management.

4. Write any two points in favor for management as a science.
   - Management principles should be verifiable.
   - Reliable basis for predicting future.

5. Write any two points in favor for management as an art.
   - Management is creative.
   - Management includes the use of practical knowledge and personal skill.

6. What is Time study?
   The movements which takes minimum time is the best one.

7. What is motion study?
   Taylor suggested that eliminating wasteful movements and performing only necessary movements.

8. Write Fayol's fourteen principles of management.
   - Division of work
   - Authority and Responsibility
   - Discipline
   - Unity of command
   - Unity of direction
   - Individual interest to general interest
   - Remuneration
   - Centralization
   - Scalar chain
   - Order
   - Equality
   - Stability
   - Initiative
   - Esprit de-corps

9. What is authority?
It is the power given to a person to get work from his subordinates.

10. What is responsibility?
It is the amount of work expected of forma man by his superior.

11. Comment: Management is both – A science and an art.
Management is a science because it contains general principles. It is also an art because it requires certain personal skills to achieve desired result.

12. What is centralization?
The organization is centralized when the power is concentrated with one person.

13. What is decentralization?
The power is fully distributed to the subordinates of the organization.

14. What is scalar chain?
The instruction and orders should be sent from the top management to the lower management.

15. What are management levels?
- Top-level management.
- Middle level management
- Lower level management

16. Write some important functions of top management.
- To formulate goals and policies of the company.
- To formulate budgets
- To appoint top executives

17. Write any two functions of middle level management.
- To train, motivate and develop supervisory level.
- To monitor and control the operations performance.

18. What are essential skills needs for the manager?
- Technical skill.
- Human skill
- Conceptual skill

19. Write the function of management.
- Planning
- Organizing
- Staffing
- Coordinating
- Controlling

20. What is social responsibility?
Society is the part of the management to initiate actions either to protect social interest of the society.

21. List out the groups' responsibilities of management.
- Shareholders
- Employees
- Customers
- Creditors

- Suppliers

22. What is ethics?
All individuals in business or non-business activities are concerned with some standardized form of behavior are known as ethics.

23. What is ethics in management?
- Business ethics deals with morality of the business environment.
- Business ethics relate to the behavior of a businessman in a situation.

24. What is partnership?
A partnership is an association of two or more persons to carry on business and to share its profit and losses in an agreed ratio.

UNIT II – PLANNING

1. What is planning?
Planning is the process of selecting the objectives and determining the course of action required achieving these objectives.

2. State the important observations suggested about planning.
- Planning is outlining a future course of action in order to achieve on objective.
- Planning is looking ahead.
- Planning is getting ready to do something tomorrow.
- Plan is a trap laid down to capture the future.

3. List out the features of planning.
- Planning – a primary function
- Planning - a dynamic process
- Planning – based on objectives and policies
- Planning – a selective process
- Planning – an intellectual process
- Planning is based on facts

4. What are the main objectives of planning?
Planning is a primary function of organization. It helps in achieving objectives. It is done to cope with uncertainty and change. It helps in facilitating control. It helps in coordination.
Planning increases organization effectiveness. Planning guides in decision making.

5. Define – mission.
Mission may be defined as a statement which defines the role that an organization plays in the society.
6. State the important questions to answer by a good mission.
- What is our business?
- What should it be?

7. Define – Objectives.
The terms objectives or goals are often used interchangeably. Objectives are the end results towards which the activities of firm are aimed or directed.

8. What is meant by strategies?
Strategy of an organization is the programme of action and deployment of resources to attain its objectives.

9. Define – Policies
Policies are general statement or understandings, which provide guidance in decision making to various managers.

10. What is procedure?
A procedure is a chronological order of actions required to implement a policy and to achieve an objectives.

11. Name any two important procedures in organization.
- Procedures for placing orders for material and equipment.
- Procedures for sanctioning different types of employee's leave.

12. Define – Budgets
A budget is a statement of expected results in numerical terms and therefore it may be referred as a numerical programme.

13. What are the advantages and limitations of planning? Advantages
- Help in achieving objectives
- Better utilization of resources
- Economy in operation
- Improves competitive strength Limitations:
- Lack of accurate information
- Time and cost
- Inflexibility
- Delay during emergency period

14. What is objective?
Objectives are the aims, purposes or goals that an organization wants to achieve over varying periods of time.

15. State the two approaches of objectives.
- Top –down approach
- Bottom –up approach

16. What is MBO?
MBO is a process whereby, the superior and the subordinate managers of an enterprise jointly identify its common goals, define each individual's major areas of responsibility in terms of results expected of him, and use these measures as guides for operating the unit and assessing the contribution of its members.

17. Mention the features of MBO.
- MBO focuses attention on what must be accomplished and not how to accomplish the objectives. It is a goal oriented rather than work-oriented approach.
- MBO tries to combine the long range goals of organization with short range of organization.
- A high degree of motivation and satisfaction is available to employees through MBO.

18. What are the major kinds of strategies and policies?
- Growth
- Finance
- Organization
- Personal
- Products or services
- Market

19. Classify policies.
    - Formulated policies
    - Appealed policy
    - Imposed policy
    - Written policies
    - Implied policies

20. Classify decisions.
    - Programmed and non-programmed decisions
    - Organizational and personal decisions

21. What is planning premises?
    The assumptions about future derived from forecasting and used in planning are known as planning premises.

22. What are the practices made in making effective premising?
    - Selection of premises
    - Collection of information
    - Development of alternative premises for contingency planning
    - Verification of the consistency of premises
    - Communication of planning premises

23. State the classification of planning premises.
    - Internal and External
    - Tangible and intangible
    - Controllable and uncontrollable

24. Define – Decision making process
    Decision – making is defined as the process of choosing a course of action from among alternatives to achieve a desired goal. It is one of the functions of management and also a core process of planning.

25. What are the techniques useful while evaluating alternatives?
    - Quantitative and Qualitative analysis
    - Marginal analysis
    - Cost effectiveness analysis

UNIT III – ORGANISING

1. Define – Organizing
   Organizing is the process of identifying and grouping of activities required to attain the objectives, delegating authority, creating responsibility and establishing relationships for the people to work effectively.

2. Mention any four characteristics of an organization.
   - Common objectives
   - Specialization or Division of labour
   - Authority of structure
   - Group of persons

3. State the advantages of organization.
   - Facilitate administration
   - Increases the efficiency of management

- Facilitates growth and diversification
- Ensures optimum use of man and material resources

4. List out the steps involved in organization process.
   - Determination of activities
   - Grouping of activities
   - Assignment of Duties
   - Delegation of authority

5. Mention the three categories of span of management.
   - Direct single relationship
   - Direct group relationships
   - Cross relation

6. What are the types of departmentation?
   - Departmentation by numbers
   - Departmentation by time
   - Departmentation by Enterprise function
   - Departmentation by Territory or Geography
   - Departmentation by customers
   - Departmentation by Equipment or process
   - Departmentation by Product or service

7. Give a note departmentation by customers.
   This type of departmentation is preferred when the needs of customers are different in nature. Some big organization is providing special services to different of customer.

8. Define – Authority
   Authority is the right to give orders and the power to exact obedience.

9. List out the sources of authority.
   - Formal authority theory
   - Acceptance authority theory
   - Competence theory

10. What is line authority?
    Line authority is the direct authority which a superior exercises over a number of subordinates to carry out orders and instructions. In organization process, authority is delegated to the individuals to perform the activities.

11. What is staff authority?
    The relationship between a staff manager and the line manager with whom he works depends in part on the staff duties.

12. List the steps involved in process of delegation.
    - Determination of result expected
    - Assignment of duties
    - Delegation of authority
    - Creation of obligation or accountability

13. What are the steps to be followed in making staff works effective?
    - Understanding authority relationship
    - Making line listen to staff
    - Keeping staff informed
    - Requiring completed staff work
    - Making staff work a way of organizational life

14. State the kinds of organizational charts.
    - Vertical chart
    - Horizontal chart or left to right chart
    - Circular chart or concentric chart

15. Define – Staffing
    Staffing is the part of the management process which is concerned with the procurement utilization, maintenance and development of a large satisfied work force on the organization.

16. Write any two roles of staffing.
    - Effective utilization of skills and potential of the work force
    - Development and maintenance of quality of work life

17. What is job analysis?
    Job analysis is a detailed study of a job to identify the skills, experience and aptitude required for the job.

18. What is job design?
    The job design is usually broad enough to accommodate people's need and desires.

19. What is job rotation?
    Job rotation refers in the movement of an employee from the job to another.

20. Define – Recruitment.
    B.Flippo defined recruitment as "the process of searching for prospective employees and simulating to apply for jobs in the organization.

21. What is selection?
    Selection is the process of finding out the most suitable candidate to the job out of the candidates attracted.

22. Write down the tests used in selection process.
    - Aptitude test
    - Intelligence test
    - Psychomotor test
    - Personality test

23. What is orientation?
    Orientation refers to the activities involved in introducing the new employees to the organization and its policies, procedures, rules, and regulations.

24. What is performance appraisal?
    Performance appraisal evaluates the performance of worker also his potential for development.

25. What are roles of manager?
    - Inter-personal role
    - Information role

- Decisional role

UNIT - IV : DIRECTING

1. Define – Multiplicity of roles
   Individuals not only the productive factor in management's plans. They are members of social system of many organizations.

2. Mention the importance of motivation.
   - Proper utilization of human resources possible since it inspires employees to make best possible use of different factors of production.
   - Proper motivation improves the efficiency of operation.
   - Motivation creates a willingness on the part of workers to do the work in a better way.

3. Name the steps involved in motivation process.
   - Analysis of situation
   - Preparing, selecting and applying a set of appropriate motivating tools.
   - Follow up

4. What are the types of motivation?
   - Positive motivation
   - Negative motivation
   - Extrinsic motivation
   - Intrinsic motivation

5. List out the basic needs in a hierarchy.
   - Physiological needs
   - Safety needs
   - Social needs
   - Esteem needs
   - Self-actualization needs

6. What is job enrichment?
   Job enrichment is therefore based on the assumption that in order to motivate personnel, the job itself must provide opportunities for achievement, recognition, responsibility, advancement and growth.

7. Who is leader?
   Leader is one who makes his subordinates to do willingly what he wants.
8. Define – Leadership
   Leadership is the process of influencing the behavior of others towards the accomplishment of goals in a given situation.

9. What is communication?
   Communication is passing of information from one person to another person.

10. State the need for communication.
    - To establish and spread goals of an enterprise widely

- To develop plans for further achievement
- To organize human and other resources in the most effective and efficient way
- To select, develop and apprise members of the organization.

11. List the different types of communication flow.
    - Downward communication
    - Upward communication
    - Horizontal or lateral communication

12. Note down the various communicating networks.
    - Simple chain
    - Wheel
    - Circular
    - Free flow
    - Inverted V

13. State the advantages of democratic leadership.
    - The subordinates are motivated by participation in decision-making process. This will increase job satisfaction.
    - Absence of leader does not affect output
    - Labour absenteeism and turn-over will be minimum.
    - The quality of decision is improved

14. What are the barriers involved in effective communication?
    - Physical barriers
    - Socio-psychological or personal barriers
    - Organizational barriers
    - Semantic barriers
    - Mechanical barriers

15. List out the effective media in communication.
    - A large bank supplies hardware and software to its customers.
    - Several banks now make bank-by-phone services available even to individuals
    - E-mail service making easy delivery of documents

16. What are the important assumptions made in X theory?
    - The average human dislikes to work. He will avoid work if it is possible.
    - Therefore people must be controlled, directed and threatened with punishment to make them work.

17. Mention the various factors involved in using motivational techniques.
    - Money
    - Participation
    - Quality of working life

18. Mention the important of leadership.
    - Motivating employees
    - Leader develops team work
    - Building morale

- Maintaining discipline

19. Name the various leadership styles.
    - Autocratic or dictatorial leadership
    - Participative or democratic leadership
    - Laissez-faire or free rein leadership

20. What is Laissez-faire?
    Complete freedom is given to the subordinates so that they plan, motivate, control, and otherwise be responsible for their own actions.

UNIT - V CONTROLLING

1. Define – Control
   According to Koontz "Controlling to the measurement and correction of performance in order to make sure that enterprise objectives and the plans devised to attain them are accomplished".

2. What are the characteristics of control?
   - Control process is universal
   - Control is continuous process
   - Control is action based
   - Control is forward looking

3. What are the disadvantages of control?
   - Control is expensive and time-consuming process.
   - Human behavior and employee morale also cannot be measured.

4. Give some critical point standards of control?
   - Cost standards
   - Revenue standards
   - Goals standards
   - Program standards

5. What are the types of control?
   - Feedback control
   - Concurrent control
   - Feed forward control

6. What is feedback control?
   Feedback control is the process of adjusting future action on basis of information about past performance.

7. What are the requirements for effective control?
   - The control should be economical
   - It must be simple
   - It should be flexible
   - It should be clear objectives

8. What are the modern techniques of control?

- Management audit
- Return on investment
- PERT and CPM

9. Define – Budgetary control?
According to J.Batty "a system which uses budgets as a means of planning and controlling all aspects of producing and or selling commodities and services".

10. Define - Budget
According to J. Fred Meston "a budget is the expression of a firms plan is financial form for a period of time in to the future".

11. What are the limitations of Budgeting?
- Inaccuracy
- Expenditure
- Distortion of goals

12. What is Zero Base Budgets?
Initially the budget is designed from a Zero base the main element is ZBB is future objective orientation.

13. What are the steps involves in ZBB?
- Decision package
- Ranking
- Allocation of resources

14. What is Internal Audit?
Internal audit is done by an internal auditor who is an employee of the organization. He examines the objectives, policies, plans, procedures and performance of the management.

15. Define – MIS
A system of obtaining abstracting, storing and analyzing data to productions information for use in planning, controlling and decision making by managers at the time they can most effectively use it.

16. What are MIS Resources?
- To provide the information up to date
- To take effective decision making
- To provide the right information available in the right form at the right time

17. Define – Productivity
Productivity is a measure of how much input is required to produce a given output the ratio is called productivity.

18. What are the factors affecting productivity?
- Technology
- Human resources
- Government policy
- Machinery and equipment
- Skill of the worker

19. What is OR?
OR is an applied decision theory, which uses scientific, mathematical and logical means to take decisions.

20. Define – Multinational Corporations
An enterprise which own or control production or service facilities outside the country in which they are based.

21. Write some advantages of MNC.
- MNC can promote quality product at lower cost.
- MNC leads to increase in production aggregate employment, exports and imports of the required inputs.
- MNC is paying taxes their operations increase government revenues.

22. What are global theories of management?
- Situational and contingency approach
- Motivation and leadership theory
- Organizational behavior

23. Write some characteristics of Japanese management.
- Japanese management prefer to human resources than it financial resources.
- Japanese management favors job security.
- Japanese are more favor to cooperation and teamwork.
- Japanese management encourages the lower level employees' participation.

24. Write some limitations of Japanese management.
- Decision making process is time-consuming process.
- Promotion policy is not encouraging outstanding younger employee.

25. Write some characteristics of German management.
- German management is autocratic.
- Managerial decisions are taken by the executive committee consultation with labour direction.
- Labour suggestions also accepted.

PART – B

UNIT-I - INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

1. Explain briefly about the scientific approach of management & also specify the features.
2. List and explain the function of management.
3. State the contributions of F.W. Taylor towards scientific management.
4. List out the 14 principles of Henry Fayol.
5. Discuss the role of manager.
6. Describe the important functions management.
7. Discuss the scope and nature of management.
8. What are the environmental factors that affect business? Explain?
9. Enumerate the trends and challenges of management the globalized era.
10. Describe about the evolution of management thought.
11. Explain about the major tendencies favoring the development of a unified global theory of management.
12. Define management .what is meant by management process? How do the required managerial skills differ in organization hierarchy?
13. Mention the different schools of management .discuss the contribution of human behavior school. (M-09)
14. With suitable example describe the various types of business organization.
15. With illustrations from Indian and international context, explain in detail the different types of business organization with their suitability.
16. Is management a science or art? & discuss the steps in method study.

UNIT II – PLANNING
PART – B

1. What is planning? Explain steps involved in planning.
2. What are objectives? How will you set objectives for a manufacturing organization?
3. Discuss various forecasting techniques normally adopted.
4. In detail explain the importance of planning in the present Indian business environment. Also highlight the different types of plans.
5. Explain in detail the steps in the Decision–making process with examples. Also explain in detail any two Decision making tools.
6. i) " Planning is looking ahead and control is looking back"-comment.
   ii) Elucidate the steps to be followed in the planning process.
7. Briefly discuss about the various tools used for developing organizational strategies.
8. Define MBO. Describe the benefits and weakness of MBO and ways to overcome them. (M-09)
9. Distinguish between programmed & non programmed Decisions and discuss the modern approaches to Decision making under uncertainty.
10. Write short notes on the following:
    i) Management by objectives
    ii) Types of strategies.
11. i) Explain the principle of planning. ii) Describe the various types of Decision.
12. With the help of block diagram, explain the process of Management by Objectives (MBO)

UNIT III – ORGANISING
PART - B

1. i) Explain the nature and purpose of organization.
   ii) Explain the qualitative forecasting.
2. Explain MBO which a focus on IT industry.

3. Name the factors determine departmentation also mention the bases of departmentation and give example.
4. Bring out the factors affecting centralization/Decentralization. Also highlight the merits and demerits of centralization/Decentralization with examples.
5. Enumerate in detail about the selection process which is widely followed in selecting IT professionals. Also highlight the different types of interviews that can be used in the selection process.
6. What do you mean by departmentation? Discuss in detail about the different strategies adopted in departmentation.
7. Describe the various steps in providing appropriate human resources.
8. Define matrix organization. Why matrix organization is used? Discuss the problems with matrix management and guidelines for making matrix management effective.
9. Analyze the position requirements, important characteristics of job design and characteristics needed by managers.
10. i) Mention the factors which are responsible for the emergence of informal organization.
    ii) What are the steps involved in the process of delegation?
11. State and explain the basic steps involved in a typical selection procedure.
12. i) Distinguish between formal and informal organization.
    ii) Explain line organization with neat sketch.

13. i) Explain the concept of Decentralization.
    ii) Explain the importance of performance appraisal.

UNIT - IV: DIRECTING
PART -B

1. i) Explain: Democratic type of leadership with examples.
   ii) Discuss two factor theory of motivation.
2. i) Explain job enrichment organizations to maintain competitiveness.
   ii) Explain the barriers in communication.
3. Explain Maslow's theory of motivation and compare and contrast XY theory
4. Discuss communication through electronic media for effective business.
5. Elucidate the different leadership styles .explain in detail about the Blake and Mouton's managerial grid.
6. Define communication .Explain the process of communication .Explain the various types of communication with its relative merits and demerits.
7. i) The various types of organizational communication.
   ii) The role of electronic media in the effective communication.
   iii) Barriers in effective communication.
8. i) Describe the relationship of hygiene factors ,motivation factors and job enrichment.
   ii) What does Maslow's hierarchy of needs tell us about people's needs?
9. i) What are the basic leadership style? Explain them critically.
   ii) What are the barriers to effective communication
10. i) Name the motivation theories .explain any two them. ?
    ii) Discuss on the components of organizational culture?
11. Discuss the different theories of motivation.

UNIT - V CONTROLLING
PART - B

1. i) What are the requirements for effective controlling?
   ii) What is role of IT controlling?
2. i) What is productivity ? Explain the methods of improving productivity in IT industry?
   ii) Explain the impact of liberalization quoting examples from software industry.
3. What are the steps in controlling process and state the essentials of effective control.

4. What is budgetary control and explain its significance.
5. Bring out the importance of productivity measures in any organization. Also enumerate the different productivity enhancement tools used by the organization in the present competitive scenario.
6. Bring out the different characteristics of an effective budget. Also bring out the different types of Budget with its relative merits and demerits.
7. Explain the traditional and modern technologies of budgeting in detail.
8. Describe the tools and techniques other than operation research for improving the productivity and discuss the future of operations research.
9. i) What are the steps involved in the process of controlling?
   ii) Give an account of some popular non-budgetary control techniques.
10. i) Define the productivity and identify the problems involved in measuring the productivity of knowledge workers.
    ii) What are the basic steps in planning the system in operations management?
11. Give an account of some popular non-budgetary control techniques, with special reference to break-even analysis and ratio analysis.
12. What tools and techniques do you suggest to improve productivity in Indian Organizations?
13. i) Explain the concept and process of controlling.
    ii) Write a note on the different types of control.

EE6005 - POWER QUALITY

TWO MARK QUESTIONS AND ANSWERS

UNIT – 1: INTRODUCTION TO POWER QUALITY

1. Define power quality .

Power quality has been defined as the parameters of the voltage that affect the customers supersensitive equipment.

2. What are the commonly used terms that describe the parameters of electrical power that describe or measure power quality.

Sag, swell, interruption, transients, harmonics, waveform distortion, over voltages, under voltages, voltage imbalance, power frequency variations, etc.

3. What is the most common power quality problem.

Voltage sags are considered the most common power quality problem.. These can be caused by the utility or by customer loads. When sourced from the utility , they are most commonly caused by faults on the distribution system. These sags will be from 3 to 30 cycles and can be single or three phase. Depending on the design of the distribution system, a ground fault on 1 phase can cause a simultaneous swell on another phase.

4. What is the second most common power quality problem.

Power quality problems are related to grounding , ground bonds and neutral to ground voltages, ground loops, ground current or ground associated issues.

5. What type of equipment is affected by power quality issues.

All electrically operated or connected equipment is affected by power quality.

6. What are the types of power quality solutions available on the market today.

There are hundreds of manufacturers making thousands of different power quality solutions today. The categories of these solutions are :

- Utility based solutions for the substation level.
- User based solution for whole facility protection.
- User load level solutions for specific loads

7. How can power quality problems be detected.

- A piece of equipment misoperates at the same time of day.
- Circuit breakers trip without being overloaded.
- Equipment fails during a thunderstorm.
- Automated systems stop for no apparent reason.

8. What are harmonics.

Harmonics are distortions in the AC waveform. These distortions are caused by loads on the electrical system that use the electrical power at a different frequency than the fundamental 50 or 60 Hz.

9. How do harmonics affect the electrical system.

In general harmonics cause magnetic portions of the electrical system to overheat.
Such as transformers, line reactors, magnetic relays and power factor capacitors.

10. How do harmonics affect the load.

The affect of harmonics on loads varies a great deal and is dependent on the load
itself. Most loads are not affected by moderate levels of harmonics . Exceptions to this are loads that perform electrical measurements in the frequency domain of the harmonics.

11. How do you measure power quality?

It requires power quality measurement equipment to measure , record and diagonos harmonic problems. Power quality instruments offer a service of characterizing all aspects of power quality and determining if it is acceptable to the load.

12. Why is power conditioning needed?

Effective power conditioning will prevent the erosion of your equipment and by filtering out these harmful properties will substantially enhance its reliability.

13. What types of equipment are affected by power line noise?

Any equipment based on semiconductor technology can be affected which includes all computers , telecommunications PBXs and key systems, automated manufacturing and design systems, computerized medical equipment and point of sale terminals.

14. Why are these transients or noise on the power line causing problems now?

Advances in digital logic technology have produced smaller and more sophisticated devices. This new generation of micro-circuitry is extremely dense and substantially more susceptible and transient damage.

15. What represent quality of power?

This term covers technical aspects as well as non-technical aspects like the interaction between the customer and the network operator. Eg. The speed with which the network operator reacts to complaints, etc.

16. What are the power quality issues?

Power frequency disturbances, power system transients, grounding and bonding, electromagnetic interference , power system harmonics, electrostatic discharge, power factor.

17. Classify power quality events in short duration events.

- Sag
- Swell
- Interruption.

18. Mention the types of sag.

- Instantaneous sag.
- Momentary sag
- Temporary sag.

19. Mention the types of swell .

- Instantaneous swell
- Momentary swell
- Temporary swell.

20. List the types of interruption.

Sustained interruption
Momentary interruption
Temporary interruption.

UNIT – 2: VOLTAGE SAGS AND INTERRUPTIONS

1. What is voltage sag?

A sag or dip is a decrease in RMS voltage or current at the power frequency for durations from 0.5 cycles to 1 minute, reported as the remaining voltage. Typical values are between 0.1 pu and 0.9 pu.

2. When sag leads to interruption.

Voltage sag is a reduction in voltage for a short time. The voltage reduction magnitude is between 10 % to 90% of the normal root mean square (RMS) voltage at 50 Hz. An interruption is a complete loss of voltage or a drop to less than 10 % of nominal voltage in one or more phases.

3. What are the causes of sag?

- Voltage sags are usually associated with voltage sag.
- Equipment sensitive to both the magnitude and duration of voltage sag.
- Equipment sensitive to have characteristics other than magnitude and duration.

4. What are the three levels of possible solutions to voltage sag and momentary interruption problems?

Power System Design
Equipment design
Power conditioning equipment.

5. List some industry standards associated with voltage sags.

*SEMI F47-0200 8 CBEMA curve

6. What are the sources of sags and interruption?

- sudden increase in load results in a corresponding sudden drop in voltage.
- Any sudden increase in load, if large enough will cause a voltage sag in motors, faults, switching.
- Recloser operation.

7. Give some economic impacts due to sag.

- Process outrages
- Damaged products
- Lost time for restarting.
-

8. What is the importance of estimating sag performance?

It is important to understand the expected voltage sag performance of the supply system so that facilities can be designed and equipment specifications developed to assure the optimum operation of production facilities.

9. What are the various factors affecting the sag magnitude due to faults at a certain point in the system.

- Distance to the fault
- Fault impedance
- Type of fault
- Pre-sag voltage level
- System configuration
- System impedance
- Transformer connections.

10. Name the different motor starting methods.

Resistance and reactance starters
Autotransformer starters
Star-Delta starters

11. What are the causes for voltage sags due to transformer energizing?

- Normal system operation, which includes manual energizing of a transformer.
- Reclosing actions.

12. How voltage sag can be mitigated.

Voltage sag can be mitigated by voltage and power injections into the distribution system using power electronics based devices which are also known as custom power devices.

13. Name the three levels of possible solutions to voltage sag and momentary interruption problems.

- Equipment Design * Power conditioning equipment Power system design

13. Name any four types of sag mitigation devices.

- Dynamic Voltage Restorer(DVR)
- Active Series Compensators
- Distribution Static Compensator(DSTATCOM)
- Solid State Transfer Switches(SSTS)

14. Define Dynamic Voltage Restorer (DVR).

A DVR is a solid state power electronics switching device consisting of either GTO or IGBT , a capacitor bank as an energy storage device and injection transformers. It is connected in series between a distributed system and a load.

16. What is the important role of a DVR?

The basic idea of a DVR is to inject a controlled voltage generated generated by a forced commuted converter in series to the bus voltage by means of an injecting transformer.

17. Define active series compensation devices.

A device that can boost the voltage by injecting a voltage in series with the remaining voltage during a voltage sag condition.

18. What is the need of DSTATCOM?

It allows effective control of active and reactive power exchanges between the DSTATCOM and the ac system.

19. What is the main function of DSTATCOM?

- Voltage regulation and compensation of reactive power
- Correction of power factor
- Elimination of current harmonics.

20. What is the role of SSTS?

Can be used very effectively to protect sensitive loads against voltage sags, swells and other electrical disturbance.
It ensures continuous high quality power supply to sensitive loads by transferring , within a time of milliseconds , the load from a faulted bus to a healthy one.

UNIT III - OVERVOLTAGE TRANSIENTS

1. Define transient over voltages.

A transient over voltage can be defined as the response of an electrical network to a sudden change in network conditions, either intended or accidental, (e.g. a switching operation or a fault) or network stimuli (e.g. lightning strike).

2. What are the' types of transient overvoltage's?

1) Impulsive 2) Oscillatory

3. Define impulsive transients. Give example for impulsive transient over voltages .

An impulsive transient is a sudden, non-power frequency change in the steady state condition of the voltage and/or current waveforms that is essentially in one direction, either positive or negative, with respect to those waveforms.
The most common cause of this type of transient is lightning.

4. Give examples for oscillatory transient over voltages.

Switching operations within the distribution network are a major cause of oscillatory transient over voltages. Such operations include

(a) Switching of utility capacitor banks,

(b) Switching of circuit breakers to clear network faults, and

(c) Switching of distribution feeders to rearrange the network for maintenance or construction

5. What is the effect of capacitor switching transients on network?

Transients of this magnitude and duration are usually not a problem on the utility system, but they can produce problems at a user facility.

Severe over voltages can appear on user facility capacitors through a phenomenon known as voltage magnification

6. What are the causes of voltage magnification on network?

The voltage magnification will not result in capacitor damage. The problem that usually occurs is the failure or mis-operation of sensitive loads in the facility where the low voltage capacitors are installed.

7. Define voltage magnification phenomena?

The highest transient voltages occur at the low voltage capacitor bank when the characteristic frequency of the switching transient is nearly equal to the resonant frequency of the low voltage system and when the switched capacitor is ten or more times the size of the low-voltage capacitor

8. Mention the two important concerns for capacitor bank switching transients.

Voltage transients at the capacitor bank substation and neighboring substations Power quality impact on sensitive customer loads due to variations in voltage when energizing capacitor banks

9. Give the various aspects of equipment specific design and protection issues for the capacitor switching transients.

- Phase-to-ground and phase-to-phase insulation switching withstand to voltage stresses
- Controlled closing for circuit breakers (pre-insertion resistors/reactors or synchronous switching)
- Capacitor bank and substation Circuit breakers ANSVIEEE C37 requirements ./ Currentlimitingreactor requirements

10. What specify the IEEE standard for shunt power capacitors causing transient overvoltages?

The IEEE Standard for Shunt Power Capacitors, ANSI/IEEE Std. 18-1992, specifies that capacitors "may reasonably be expected to withstand" transient overvoltages from 205% to 354% of rated peak voltage, depending on the number of times a year the overvoltage occurs.

11.What are the various Causes of overvoltages?

Overvoltages, i.e. brief voltage peaks (transients, surges, spikes), can be attributed to the following main causes:

1.Atmospheric discharges, i.e. lightning (LEMP - Lightning Electro-Magnetic Pulse)
2.Switching operations in the public grid and low-voltage mains
3.Electrostatic Discharges (ESD)
4.Ferroresonance

12.Give tile basic principles of overvoltage protection of load equipments.

Limit the voltage across sensitive insulation.

Divert the surge current away from the load. Block the surge current entering into the load. Bonding of equipment with ground

13.What is the need of surge arrestors?

A surge arrester is a protective device for limiting surge voltages on equipment by discharging or bypassing surge current. Surge arresters allow only minimal flow of the 50Hz/60Hz power current to ground.

14.Differentiate between transient voltage surge suppressors (TVSS) and surge arrestors.

Arresters and TVSS devices protect equipment from transient overvoltages by limiting the maximum voltage, and the terms are sometimes used interchangeably. However, TVSSs are generally associated with devices used at the load equipment.

A TVSS will sometimes have more surge-limiting elements than an arrester.

15.Mention the types of surge arrestors

Metal-oxide varistor type Gapped silicon - carbide type

16.What is metal-oxide surge-arrester?

A metal-oxide surge-arrester (MOSA) utilizing zinc-oxide block provides the best performance, as surge voltage conduction starts and stops promptly at a precise voltage level, thereby improving system protection

17.Give any two advantages of metal-oxide arresters over conventional silicon carbide distribution class arresters.

Improved Surge Duty Capability

Improved Temporary Overvoltage Capability

18. **What is the need of Transmission Line Arresters?** '.

Transmission Line Surge Arresters conduct lightning surges around the protected insulator so that a lightning flashover is not created.

They are designed to be installed functionally in parallel with the line insulator. The arrester conducts the lightning surges around the protected insulator so that a subsequent 50Hz / 60 Hz fault on the circuit is not created.

19.Mention the Benefits of Transmission Line Surge Arresters

- Lowers initial cost of new or transmission line upgrades by making construction more compact and transmitting more energy in the same right of way.
- Reduces the height of transmission lines by eliminating shield wire

- Improves outage statistics by eliminating back flashover from the tower ground lead to the phase conductor

20.What is the role of surge arrestor on shielded and unshielded transmission line?

On shielded transmission lines or under-built distribution circuits, the arrester prevents tower to phase insulator back-flashovers during a lightning strike.

On unshielded sub transmission or distribution circuits, the arrester prevents phase-to-ground flashover.

21.What is the need of low pass filter in transient protection?

- This LC combination provides a low impedance path to ground for selected resonant frequencies.
- Low-pass filters employ pi principle to achieve better protection even for high- frequency transients.

22.What is tire need of Shunt protectors or surge reduction filters?

- An in-line filter specifically designed to reduce the rate of voltage rise (dv/dt) of the pre-clamped waveform.
- It gives some series impedance between input and output terminals. This type of product is highly recommended for the protection of sensitive electronic equipment

23. What is the application of Power Conditioners in transient protection?

Low-impedance power conditioners are used primarily to interface with the switch-mode power supplies found in electronic equipment. Low-impedance power conditioners differ from isolation transformers in that these conditioners have much lower impedance and have a filter as part of their design 1.When on the device to position the power conditioners to avoid voltage swells.

24. Differentiate between TVSS, Filter and Data/signal protection devices.

Transient: focus on limiting high-voltage spikes to an acceptable level.

Filtering: protect against low-energy transients and high frequency noise and finally Data/signal protection devices: Products that guard sensitive instrumentation against what we refer to as 'back door' transients and noise

25. Define lightning phenomena.

Lightning is an electrical discharge in the air between clouds, between different charge centre within the same cloud, or between cloud and earth (or earthed object). Even though more discharges occur between or within clouds, there are enough strokes that terminate on the earth to cause problems to power systems and sensitive electronic equipment

26. How Overvoltages are induced due to lightning?

When lightning strikes occur in or near an electricity distribution system, lightning currents are generated and conducted through the power system into connected equipment.

Large impulsive transient over voltages are produced as a result of this current flow.

27. What are the various causes due to lightning overvoltages?

- In transmission systems, the insulation is generally sufficient enough not to be endangered by induced voltages. However, distribution systems in which the insulation level is low, induced voltages are hazardous.
- When the induced voltage caused by lightning exceeds the strength of the insulation, a line flashover results, causing either temporary faults or disruption of services to customers

28. What is the range of current induced due to lightning stroke?

The majority of the cloud to ground lightning strokes varies from kilo-Amperes to several tenths of kilo-amperes. Strokes above 100000 amperes are rare, and the highest reported peak value of the return stroke current is 200000 A. The shape of the current wave and the related voltage wave is rather capricious and different for every stroke.

29. What is ferroresonance?

Ferro resonance is a special case of series LC resonance where the inductance involved is nonlinear and it is usually related to equipment with iron cores. It occurs when line capacitance resonates with the magnetizing reactance of a core while it goes in and out of saturation.

30. Define ferroresonance phenomena.

The phenomena of ferroresonance is a name given to a situation where the nonlinear magnetic properties of iron in transformer iron core interact with capacitance existing in the electrical network to produce a nonlinear tuned circuit with an unexpected resonant frequency. This phenomenon poses a hazard to an electric power system because it generates overvoltages and over currents.

31. What are the problems associated with ferroresonance?

Transformer overheating Audible noise
High overvoltages and surge arrester failure

32. What are the various capacitance produced by power system elements?

a) The circuit-to-circuit capacitance
b) Parallel lines capacitance
c) Conductor to earth capacitance
d) Circuit breaker grading capacitance
e) Bus bar capacitance
f) Bushing capacitance

33. List some common circumstances leading to ferroresonance problems.

Some common circumstances leading to ferroresonance include transformer fuse blowing, line or switch fuse blowing, energizing a new transformer by manual cable switching up-line from transformers, cable connector or splice opening, manual cable switching to reconfigure a cable circuit during emergency conditions, and open conductor fault in overhead line feeding cable.

34. Mention the common methods used for utility for protecting distribution transformer.

Generally utility to provide two common ways for protecting distribution transformer:

1. Use transformers with interlaced secondary windings.
2. Use surge arresters at low voltage terminals

35. Which are the most widely used protection devices in protection of transformer? Also list the types mostly used.

Usually, in distribution transformers, MOV type surge arresters are used for overvoltage protection.
External Live Front arresters Under Oil arresters
External Elbow arresters

36. Give the cable life equation as a function of impulses.

The cable life is an exponential function of the number of impulses of a certain magnitude that it receives, according 10 Hopkinton. The damage to the cable is related by

$$Dc = P \cdot Ve$$

P = Number of impulses

V = Magnitude of impulses

e = empirical constant ranging from 10 to 15

37. List the important types of arrestor used in protection of cable.

(i) Under oil arresters
(ii) Elbow arresters
(iii) Lower discharge arresters

38. What is the need of Computer analysis tools for transient studies?

Computer analysis simulation tool can simulate the time response of the transient phenomena in the power system with a very high degree of accuracy.

39. List the advantages of computer analysis tools for transient studies.

The application of commercial time-domain simulation packages (PSCAD/EMTDC) has many advantages over the conventional mathematical analytic methods, in terms of:

1. There being no need to develop a complex nonlinear differential equation for the system;
2. The complex power system phenomena such as ferroresonance, harmonics, etc being easily modeled with modules of lines, transformers, power converters, loads and protection equipment from the library.

40. What is the need of PSCAD/EMTDC?

- EMTDC (Electromagnetic Transients including DC) represents and solves differential equations for both electromagnetic and electromechanical systems in the time domain.
- Solutions are calculated based on a fixed time step, and its program structure allows for the representation of control systems, either with or without electromagnetic or electromechanical systems present

41. Give any two analysis examples available in PSCAD/EMTDC? Transient Studies

- Transient over voltage studies (TOV)
- Line energizing (charging and discharging transients)
- Capacitor bank back to back switching, selection of inrush and out-rush reactors

Power Quality

- Voltage dips, swells and interruptions
- Induction motor starting
- System faults
- Voltage fluctuation

42. How to model a surge arrestor in PSCAD? (Anna University April/may-2008)

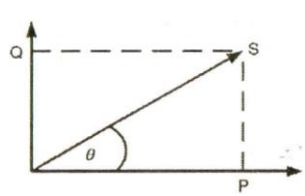
The frequency dependent model which was recommended by IEEE WG 3.4.11 (1992) is the most accurate representation based on single phase line model.

UNIT IV HARMONICS

1. What are the important concepts to bear in mind to understand power system harmonics?

There are two important concepts to bear in mind with regard to power system harmonics. The first is the nature of harmonic current producing loads (nonlinear loads) and the second is the way in which harmonic currents flow and how the resulting harmonic voltages develop.

2. Draw the relationship between between P, Q, S in sinusoidal condition.



3. Define true power factor.

True power factor is calculated as the ratio between the total active power used in a circuit (including harmonics) and the total apparent power (including harmonics) supplied from

the source

True power factor = Total active power (P) / apparent power (S)

4. What is the reason for existence of harmonic distortion?

Harmonics distortion exists due to the nonlinear characteristics of the devices and loads on the power system .
These devices act as current sources that inject harmonic currents into the power system.

5. Differentiate between linear loads and non-linear loads.

Linear load: Any load that draws current at supply fundamental frequency only is a linear load. The current drawn does not contain any harmonics (multiples of the supply frequency). Motors, resistors, inductors and capacitors are all linear loads.

Non Linear load: Any load that draws harmonic currents from the supply is a nonlinear load. The current waveform of such non-linear loads, is discontinuous and non sinusoidal because of the presence of harmonics.

6. What is voltage and current distortion?

- Voltage distortion is any deviation from the nominal sine waveform of the AC line voltage .
- Current distortion is any deviation from the nominal sine waveform of the AC line current.

7. Mention the commonly used indices used for measuring harmonic component of waveform.

The two most commonly used indices for measuring the ham10nic content of the waveform are the total harmonic distortion (THD) and total demand distortion (TDD).

1. If a generator produces a non-ideal sinusoidal waveform, the voltage waveform will contain a certain amount of harmonics
2. In motors, decreased efficiency, excessive heating, and vibration are symptoms of harmonic voltage distortion.

8. Mention at least two causes of harmonics made on distribution systems.

In the distribution system, transformers are capable of producing harmonics due to magnetic core saturation. This is more prevalent at a lighter loading of the transformer

Large load currents in the neutral wires of a 3 phase system. Theoretically the neutral current can be up to the sum of all 3 phases therefore causing overheating of the neutral wires. Since only the phase wires are protected by circuit breakers of fuses, this can result in a potential fire hazard.

9. What is harmonic index? State its significant.

The power quality industry has developed certain index values that help us assess the quality of service as it relates to distortion caused by the presence of harmonics. These values, or
harmonic indices, serve as a useful metric of system performance. The two most commonly used indices under harmonic studies are

(a) Total harmonic distortion (TI-ID) (b) Total demand distortion (TDD)

10. Mention the problems created by harmonics.

A large load current flows in the neutral WIres of a 3 phase system.

Theoretically the neutral current can be up to the sum of all 3 phases therefore causing overheating of the neutral wires. Poor power factor conditions that result in monthly utility penalty fees for major users (factories, manufacturing, and industrial) with a power factor less than 0.9.

11. Mention the harmonic effects on devices and loads Insulation stress (voltage effect)

Thermal stress (current effect) Load ruptures (abnormal operation)

12. What is the effect on transformer due to Harmonics?

The primary effect of power system harmonics on transformers is the additional heat generated by the losses caused by the harmonic contents generated by the load current

13. Mention he harmonic sources from commercial loads.

Single phase loads such as Switch mode power supplies, fluorescent lighting and UPS systems
Three phase loads such as high voltage AC drives system

14. Mention the harmonic sources from industrial loads .

Three phase converter with Adjustable speed drives (DC drives and AC drives) Arcing Devices (Arc furnaces, weiders, Discharge lamps etc) Saturable devices (transformer, electromagnetic devices etc with steel core)

15. What is the advantage of three phase converter?

Three-phase electronic power converters do not generate third-harmonic currents mainly when compared with single-phase converters. This is a great advantage because the third harmonic current is the largest component of harmonics shown in harmonics spectrum

16. What is the disadvantage of 12 pulse drive?

The disadvantages of the l2-pulse drive are that there is more cost in control design and an extra transformer is usually required

17. State the different types of inverters

Variable voltage inverter (VVI) Current source inverter (CSI) Pulse width modulated (PWM)

18. What is Variable Voltage Inverter?

The variable voltage inverter (VVI), or square-wave six-step voltage source inverter (VSI), receives DC power from an adjustable voltage source (either from thyristor converter or DC-DC converter fed by Diode Bridge) and adjusts the frequency and voltage.

19. What is current Source inverter?

The current source inverter (CSI) receives DC power from an adjustable current source and adjusts the frequency and current.

20. What is the need of locating harmonic sources?

When harmonic problems are caused by excessive voltage distortion on the supply system, it is important to locate the sources of harmonics in order to develop a solution to the problem.

UNIT V POWER QUALITY MONITORING

1. What is the importance of power quality monitoring?

Power Quality Monitoring is necessary to- detect and classify disturbance at a particular location on the power system. PQ monitoring assists in preventive and predictive maintenance. Problems can be detected before they cause widespread damage by sending automated alerts. PQ Monitoring can be used to determine the need for mitigation equipment.

2. What are the monitoring objectives*?*

- Continuous evaluation of the electric supply system for disturbances and power quality variations.
- Document performance of power conditioning equipment, such as static switches, UPS systems, other ride through technologies, and backup generators.

3. What are the purposes of power quality monitoring system?

- Preventive maintenance
- Load analysis
- Equipment diagnostics
- Long time surveys

4. What is proactive monitoring*?*

The traditional approach to power quality monitoring is reactive. We need to know when a problem is going to occur before it happens. Permanent power quality monitoring systems are designed to help proactively identify conditions and events that may cause problems should be addressed. This is called proactive monitoring. The response of equipment that may be sensitive to microsecond variations in the voltage.

5.**What are the steps involved in power quality monitoring***?*

- Planning for the monitoring
- Preparing for the monitoring
- Inspecting the site
- Monitoring the power
- Analyzing, monitoring and inspecting data
- Applying corrective solutions

6. **What are the requirements of monitoring for a voltage regulation and unbalance?**

- 3 phase voltages
- RMS magnitudes
- Continuous monitoring with periodic max/min/avg samples

7.**What are the requirements of monitoring for a harmonic distortion?**

- Currents for response of equipment
- 3 phase voltages and currents
- Waveform characteristics
- 128 samples per cycle minimum
- Synchronized sampling of all voltages and currents
- Configurable sampling characteristics

8. **What are the Characteristics of power quality monitoring equipment***?*

Harmonic Analysis

Harmonic analyses are usually conducted by obtaining and interpreting measurements of waveforms. Equipment normally required to perform a harmonic study consists of a harmonic analyzer, an oscilloscope, and an RMS responding voltmeter and ammeter. Spectrum analysis is usually performed up to the 50th harmonic (3 kHz).

9. What are the Characteristics of power line monitors?

- Portable, rugged, lightweight
- Simple to use, with proper training
- Designed for long-term unattended recording
- Definition of line disturbance parameters varies between manufacturers

10. What is the Types of power quality measurement equipment*?*

- Hand-held single-phase power quality monitors
- Portable three-phase power quality monitors
- Harmonic analyzers
- Distortion analyzers
- Multimeters

11. Mention the factors that should be considered for selecting the instrument.

- Number of channels (voltage and/or current)
- Temperature specifications of the instrument
- Input voltage range (e.g., a to 1000 V)
- Ability to measure three-phase voltages

12. **What is the use of oscilloscope***?*

Oscilloscopes with fast sampling rates and automatic triggering function can be very useful for trace of transients.

13. **What is the use of spectrum analyzer***?*

A spectrum analyzer can be used for trace of high frequency harmonics.

14. What is the use of simple single phase hand-held power quality monitor?

Power quality problems like measuring the occurrence of harmonics or checking the voltage level or the power frequency can easily be made by using a simple single phase hand-held power quality monitor.

15. Mention the Instruments used for the analysis of non-sinusoidal voltage and currents*?*

- Oscilloscope
- Spectrum analyzer
- Harmonic analyzer

16. **Mention the basic categories of instruments for harmonic analysis?**

- Simple meters
- General-purpose spectrum analyzers
- Special-purpose power system harmonic analyzers
- Digital Harmonics Measuring Equipment
- Distortion Analyzers
- Data Logger

17. What is Spectrum analyzer?

An instrument used for the analysis and measurement of signals throughout the electromagnetic spectrum. Spectrum analyzers are available for sub audio, audio, and radio-frequency measurements, as well as for microwave and optical signal measurements.

18. What is the operation of spectrum analyzer*?*

A spectrum analyzer separates the signal into two components: amplitude (displayed vertically) and frequency (displayed horizontally). In some low frequency analyzers, phase information can also be displayed.

- Low-frequency analyzers are sometimes called as ***"Harmonic analyzers"***
- Vertical scale displays the amplitude and horizontal scale displays the frequency.

19. **What is Swept heterodyne technique?**

Any signal at the input, at a frequency such that the difference between its frequency and the local oscillator is within the bandwidth of an intermediate- frequency filter, will be detected and will vertically deflect the spot on the display by an amount proportional to the amplitude of the input signal being analyzed.

20. **What is FFT (or) digital technique used for harmonic analysis***?*

The signal to be analyzed is converted to a digital signal by using an analog to digital converter, and the digital signal is processed by using the FFT algorithm. The algorithm analyzes the time domain waveform, computes the frequency components present, and displays the results.

21. **What are the advantages of FFT***?*

- FFT technique is much faster.
- Measurement is virtually real time.

22. **What are the disadvantages of FFT***?*

- Restricted to lower frequencies.
- Complex due to need of A/D converter.

23. **What is the use of digital storage***?*

Digital storage gives the effect of a constant display, even though a very slow sweep may have been used to acquire the displayed data.

24. **What is tracking generator***?*

The tracking generator enhances the applications of spectrum analyzers. Its output delivers a swept signal whose instantaneous frequency is always equal to the input tuned frequency of the analyzer.

25. **What is harmonic analyzer***?*

Spectrum analyzers covering up to typically 100 kHz can also be called harmonic analyzers.

UNIT I - INTRODUCTION TO POWER QUALITY
PART B

1. (i) Name and explain different types of power quality issues that affects the power systems depending upon the severity?
(ii)Define Total Harmonic Distortion. Explain the procedure for calculation the Total Harmonic Distortion (THD) due to disturbance in the power system

2. (i) Discuss the following characteristics of power quality issue (a) Short duration variations
(b) Long duration variations
(ii)Discuss in detail about transients

3. (i) Describe the CBEMA and ITI curve (ii)Define waveform distortion and explain the waveform distortion categories

4. write short notes on following power quality issues
(i) Harmonics (ii) Power frequency variations.

5. Discuss the source and effects of different categories of long duration voltage variations that affect the power quality

6. Explain power quality and explain the reasons for increased concern in power quality

7. Discuss the following electrical power quality issue with examples
(a) Voltage swell
(b) Voltage interruption

8. Explain the various types of power quality disturbances in power system and also explain the characteristics of each disturbance.

9. (i)Summarize the impact of poor power quality on utility and consumers
(ii) Discriminate on over voltage and under voltage in power quality issue

10. Formulate different categories and characteristics of power quality disturbance in power system network and point out which disturbance have most affect the power quality

11. Explain total harmonic distortion and total demand distortion

12. (i) Demonstrate the major reasons for the growing concern about the quality of electric power by both Electric utilities and end users
(ii) Illustrate the principle phenomenon causing electric magnetic disturbance classified by International Electro technical commission

13. With a waveform sketch, explain the terms
(a)Voltage sag
(b)Voltage interruption
(c)Voltage swells
(d)Sag with harmonics

14. How the power quality affect due to the different power factor in the power system due to inductance and capacitance effect

UNIT II - VOLTAGE SAGS AND INTERRUPTIONS
PART B

1. (i)Explain the sources of sags in power system
   (ii) Discuss the sources of interruption to affect the power quality

2. (i)Describe in detail about the sag performance evaluation indices.
   (ii)Describe the methodology of estimating voltage sag performance

3. Explain the following causes of sag
   (i) Voltage sag to motor
   (ii) Voltage sag due to single line to ground fault
   (iii) Voltage sag due to transformer energizing

4. (i) Explain various indexes used to estimate voltage sag
   (ii) Discuss some of the solutions for voltage sag and interruption

5. What is the need for estimating sag performance Explain the different methods of estimating voltage sag performance

6. Analysis and calculation of power quality due various faulted condition

7. Analyze about estimating the cost of voltage sag events in the power system .

8. (i) Explain active series compensator to compensate the voltage sag occurs in power system
   (ii) Explain how ferro resonance transformer to improve the voltage sag performance

9. (i) Explain the solid state transfer switch with transfer operation
   (ii)Explain fast transfer switch with transfer operation

10. Explain performance voltage sag due to starting of large induction motor in distribution level

11. Explain the operation of Distribution Static Compensator (DSTATCOM) used for sag mitigation

12. Analyse the different methods for estimating voltage sag severity due to the disturbance in the power System

13. What ate the different voltage sag mitigation techniques? Explain the principle of operation of DVR used for sag mitigation

14. What are the different voltage sag mitigation techniques? Explain in details.

UNIT III - OVERVOLTAGES
PART B

1. Analyze the source of transient over voltages in power systems.

2. Write short notes on the following:
   (i) Low pass filters
   (ii) Power conditioner

3. (i) Explain the problems associated with Ferro resonance.
   (ii)What are the different sources of transient over voltages? Discuss the capacitor switching transient.

4. (i) Explain the underground cable system protection.
   (ii)Explain in detail about the protection of transformer.

5. Write short notes on the following:
(i) Lightning arrestor
(ii) Line arrestor

6. Illustrate the phenomena of impulsive transients and oscillatory transients.

7. Discuss the source of overvoltage due to following phenomena.
(i) Capacitor switching.
(ii) Magnification of Capacitor switching transients.

8. List the fundamental principles of overvoltage protection of load equipment.

9. (i) Explain in detail about the surge arrestors and surge suppressors for over voltage protection.
(ii)What are the advantages of surge arrestors? Discuss about the application module?

10. (i) What are the various lightning protection schemes used for over voltage lines? Integrate them.
(ii)Evaluate the use of PSCAD in analyzing the power quality.

11. Describe the sources of transient over voltages in high, medium and low frequency range.

12. Describe different methods of protection of transformers and cables against voltage transients.

13. (i) Prepare short note on shielding
(ii)Explain the "Ferro Resonance" in detail.

14. (i) Define lightning. Discuss in detail about the over voltages due to lightning and the problems associated with it.
(ii)What are the advantages of computer analysis tools? Generalize about PSCAD and EMTP for transient studies?

UNIT IV - HARMONICS
PART B

1. (i) Explain briefly how the phenomena of current distortion affects the voltage distortion under the presence of harmonics.
(ii) Explain briefly about locating harmonic sources.

2. (i) Explain the power system response characteristics under the presence of harmonics.
(ii)What is the need of IEEE standards used in harmonics studies? Give their philosophy and objectives of these standards.

3. (i)Explain the fundamentals of harmonics generation and waveform distortion.
(ii) Prepare the following terms
(a) Current distortion
(b) Voltage distortion

4. Discuss the effects of harmonics on electrical power components.

5. Write short note on the active filter and passive filter in controlling harmonic distortion.

6. Explain how commercial and industrial loads are responsible for harmonic distortion

7. (i) Write short notes on THD and TDD.
(ii)Discuss the effects of harmonic distortion on transformers and motors.

8. (i) What is meant by point of common coupling? Generalize the IEEE 519 standard and IEC 61000-3-2 standard with respect to harmonics.

9. (i) Demonstrate about evaluation of harmonic distortion.
(ii) Define the following terms related with IEEE standards .
(a) SCR
(b) Total harmonic distortion.

10. Write short notes on the following.
(i) Harmonic indices
(ii) Inter harmonics

11. (i) Discuss in detail about IEC standards on harmonics.
(ii) What are the filters in harmonic analysis? Explain active and passive filters

UNIT V - POWER QUALITY MONITORING
PART B

1. Explain in detail with necessary diagram the working principle and functioning of power quality analyzers

2. Briefly discuss the common objectives of power quality monitoring.

3. (i) Bring out the important characteristics of power quality variations.
(ii)Explain the steps involved in power quality monitoring. What are the information from monitoring site surveys?

4. (i) Explain the various instruments used for power quality measurements.
(ii) What are the factors to be considered when selecting the instruments?

5. Illustrate the importance of power line analyzer.

6. Explain the features of spectrum analyzer and flicker meters.

7. Describe the modeling of power quality problems by mathematical solution tools.

8. Write short note on the following.
(i) Disturbance analyzer
(ii) Flicker meter

9. Analyze the role of expert systems in power quality monitoring.

10. (i) Explain in detail about the flicker meter.
(ii)Explain the application of expert system for power quality monitoring.

11. Design the block diagram of advanced power quality monitoring systems. Explain it in detail.

12. (i) Bring the significance of power quality maintaining? Demonstrate the objectives of power quality maintaining?
(ii)Write short notes on power quality measurement system. What are the characteristics of power quality measurement equipments?

13. (i) Discuss briefly about the different features of harmonic analyzer.
(ii)Design and explain about power quality disturbance analyzer.

14. Explain the instrument used for power quality monitoring. With neat sketch explain the working of fuel cell and give its advantages.

EE6007 - MICRO ELECTRO MECHANICAL SYSTEMS

TWO MARKS AND 16 MARKS

UNIT I- INTRODUCTION

1. what is miniaturization ?

An Inspiration by Richard Feynman In one of the most frequently quoted classical papers of our recent time a Nobel Laureate by the name of Richard Feynman offered "a field, in which little has been done, but in which an enormous amount can be done in principle" this field is miniaturization.

2. what are the types of scaling laws ?

① Scaling in Geometry
Scaling of physical size of objects.

②. Scaling of phenomenological
Scaling involves both the size & material properties of the system.

3) what are thermal transducers ?

①. Thermo - mechanical sensors
②. Thermoresistive Sensors
③. Thermo couples.

4) what is actuator ? what are the types of actuators ?

Actuators offers a wide variety of performance and operate in many different ways. For the present analysis an actuator is defined to be a controllable work producing machine.

In the following section a brief description is given of each of the classes of actuators and of the limitation to their performance.

(a) Piezoelectric actuators.

(b). Shape memory alloy actuators.

5) Define strain ?

Strain is defined as the amount of deformation an object experiences compared to its original size and shape. For example, if a block 10 cm on a side is deformed so that it becomes 9 cm long, the strain is (10-9)/10 or 0.1 (sometimes expressed in percent, in this case 10 percent). Note that strain is dimensionless.

6). Define stress ?

Stress is defined as force per unit area. It has the same units as pressure, and in fact pressure is one special variety of stress. However, stress is a much more complex quantity than pressure because it varies both with direction and with the surface it acts on.

7) List out the basic mems materials ?

Silicon compounds and materials are

① Silicon dioxides (SiO_2),

② Silicon nitrides (Si_3N_4),

③ Silicon carbides (SiC)

④ Polycrystalline silicon and metals such as [illegible] polymers such as polyimid

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8) what are the general criteria while selecting or designing actuator ?

1. Torque and force output capacity
2. Range of motion
3. Dynamic response speed and bandwidth
4. Ease of fabrication and availability of materials
5. power consumption and energy efficiency
6. Linearity of displacement as a function of driving bias
7. cross sensitivity and environmental stability
8. footprint

9) what is charge carrier ?

Generally, carrier refers to any object that carry another object from one place to another place. For example, in countries such as India, Tiffen box widely used to carrying food from one place to another place, here the tiffen box acts as a carrier that carries the food from one place to another place. It is charge carrier.

10) what are the methods of determining beam deflection ?

Numerous methods are available for the determination of beam deflections. these methods include.

① Double integration method
② Area moment method
③ Strain-energy method (Castigliano's Theorem)
④ Conjugate-beam method
⑤ Method of superposition

SIXTEEN MARK QUESTIONS

1) Describe elaborately about the intrinsic characteristics of MEMS?
2) Explain the field of MEMS with the importance sensors, transducers and actuators?
3) Elaborate in detail about micro fabrication process?
4) What are the major advantages offered by MEMS Technology?
5) Lit out the features of miniaturization?
6) Explain about different scaling laws in view of MEMS?
7) Write about sensors and its characteristics, selection factors?

Two mark Questions and Answers

1) List the merits and demerits of capacitive Sensors?

MERITS

① The capacitive accelerometers based on surface micromachining allow low cost mass production and have been widely used in applications such as air-bag deploying systems in automobiles.

② High sensitivity and high resolution accelerometers can be achieved with capacitive sensing using bulk micromachining technologies.

Drawbacks

①. Capacitive sensors are inherently nonlinear.

②. As the output is capacitance change, electronics circuit is a mandatory requirement for converting the capacitance to voltage.

2) what are the difficulties associated with capacitive pressure sensor?

①. It is difficult to interconnect the metal electrode out of the vacuum chamber without jeopardizing the hermetic seal.

②. The vacuum in the cavity is not easy to maintain due to the degassing of the material in the process of electrostatic bonding and after encapsulation.

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3) what is the purpose of capacitive microphone?

A microphone is a sensor for detecting sound. It is a device capable of transforming a pressure signal of sound into an electric voltage signal. Therefore a microphone is in essence a very sensitive pressure sensor for an alternative pressure in sound frequency.

4) what are the types of comb drives?

Types are comb drives.

① . Transverse comb - drive

② . longitudinal comb drive.

5) What are the types of MEMS micro motors?

①. Linear motors

②. Rotary motors.

6) what are the types of thermal sensors?

Depending on the principle of operation, thermal micro sensors are categorized into three different types of sensors.

①. Thermoresistive sensors

②. Thermo mechanical sensors

③ Thermocouples.

7) what is piezo pump?

Another type of micropump, called a piezo pump is built on the principle of producing wave motion in the flexible wall of minute tubes in which the fluid flows. piezoelectric materials coated

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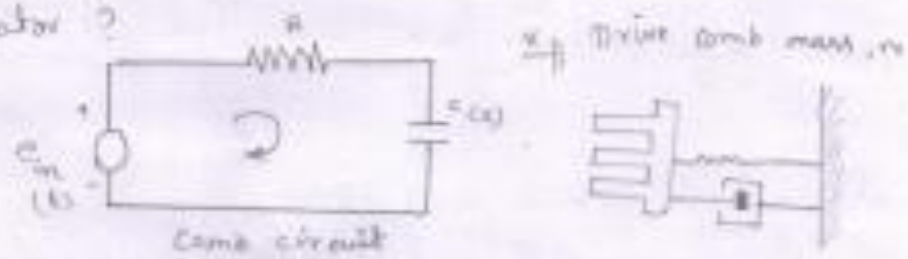
outside the tube wall generate the wave motion. The wave motion of the tube wall exerts forces on the contained fluid for the required motion.

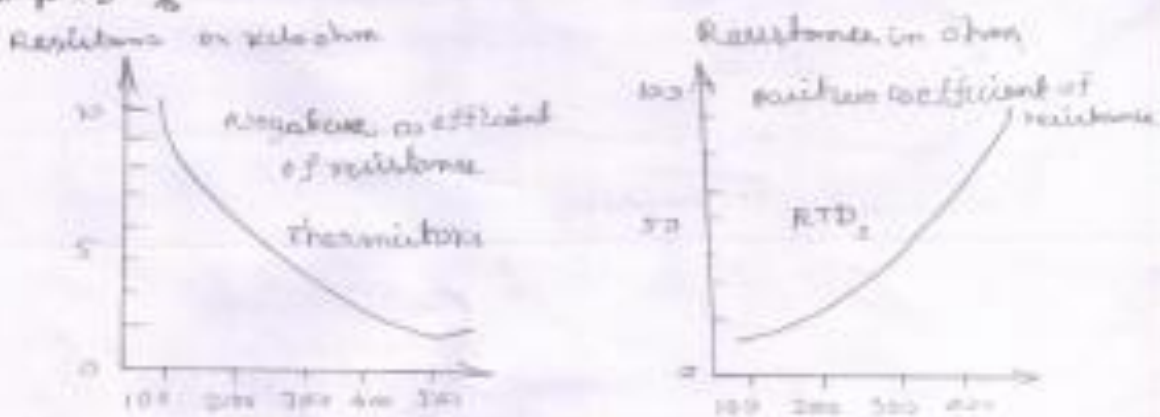
8) List the advantages of magnetic actuators?

1. High actuation force and stroke
2. Direct, fully linear transduction.
3. Bi-directional actuation.
4. Contactless remote actuation
5. Low-voltage actuation

9) Draw the schematic diagram of MEMS comb drive actuator?



10) Draw the temperature resistance curve of thermistor and RTD?



11) What are the basic block of magnetic actuators?

1. Fuel injectors in engines of automobiles, trucks & locomotives
2. Loud speakers
3. Head positioners for computer disk drives
4. Switch gear and relays for electric power transmission and distribution.
5. Contactors, circuit breakers, and relays to control electric motors and other equipment.

SIXTEEN MARK QUESTIONS

1) Explain in details about the parallel plate capacitor based sensing?

2) What is the working principle of Electrostatic Sensor?

3) What is comb drive driver, why it's so called?

4) Explain the purpose and operation of interdigitated finger?

5) Write about SMA and SME.

6) List the basic magnetic materials utilized for magnetic sensing and actuation?

7) Explain the neat diagram actuation using shape memory alloys.

8) Explain the working of MEMS thermocouples and Thermal Bimorph.

TWO MARKS QUESTIONS AND ANSWERS

1) what is meant by piezo resistive sensor?

Piezo means pressure and resistive means the opposition to DC current flow. Thus a piezoresistive sensor is a device that changes resistance as a function of applied pressure. Piezoresistive sensors are silicon based devices. Silicon is the second most common element on earth - sand, quartz, agate, and opals are a few of the forms in which the oxide appears. Silicon is a principal ingredient of glass and an important ingredient of steel.

2) what are the advantages of micro mechanical piezoresistive sensors?

1. The resistors on the membrane can be configured in a bridge.
2. The resistors have nearly the same temperature, due to the high thermal conductivity of silicon
3. Interface electronics, including further temperature compensation circuits, can be integrated with the sensor bridge on the same substrate.

3) what are the groups of piezo eletric materials?

materials that exhibit a significant and useful piezoelectric effect fall into three main groups;

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1. natural (quartz, Rochelle Salt) and
2. Synthetic crystals (Lithium Sulphate, ammonium dihydrogen phosphate).
3. polarized ferroelectric ceramics and certain polymer films

4) what is piezoelectric effect?

Piezoelectric effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. The word piezoelectric is derived from the Greek piezein, which means to squeeze or press, and piezo which is Greek for 'push'.

5) List piezo electric materials? Give example?

the most commonly known piezoelectric material is quartz. But piezoelectric materials are numerous, the most used are

1. zinc oxide (ZnO)
2. Aluminium Nitride (AlN)
3. polyvinylidene fluoride (PVDF)

6) what are the advantages of piezo resistive sensors?

1. all piezoresistors are deposited in one processing step resulting in almost identical properties
2. The resistors on the membrane can be configured in a bridge
3. The resistors have nearly the same temperature due to the high thermal conductivity of silicon.
4. Interface electronics, including further temperature compensation circuits, can be integrated with the sensors bridge on the same substrate

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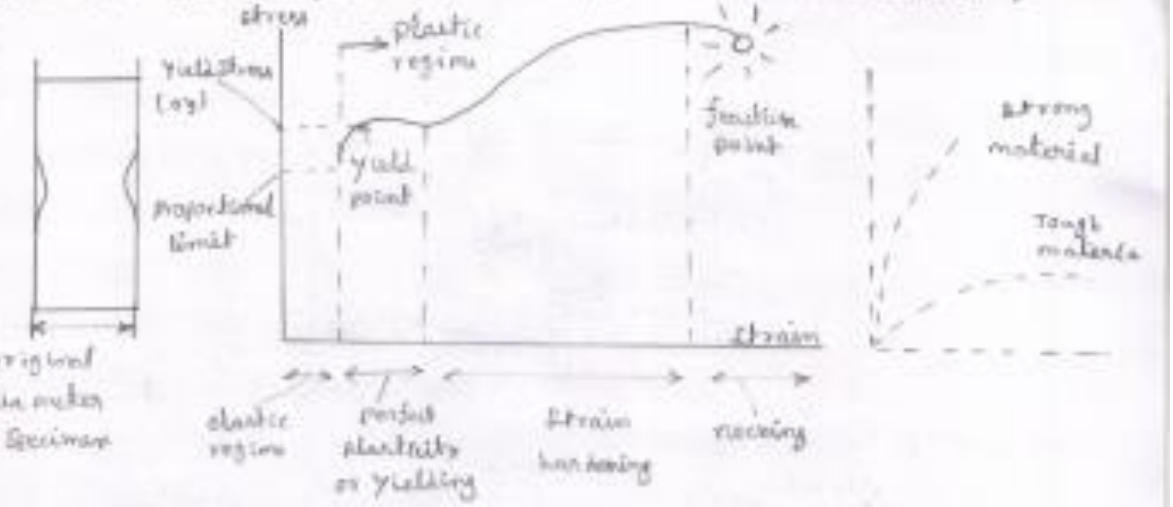
7) i) Draw the stress strain curve of mems material ?



8) write the equation of piezoresistivity ?

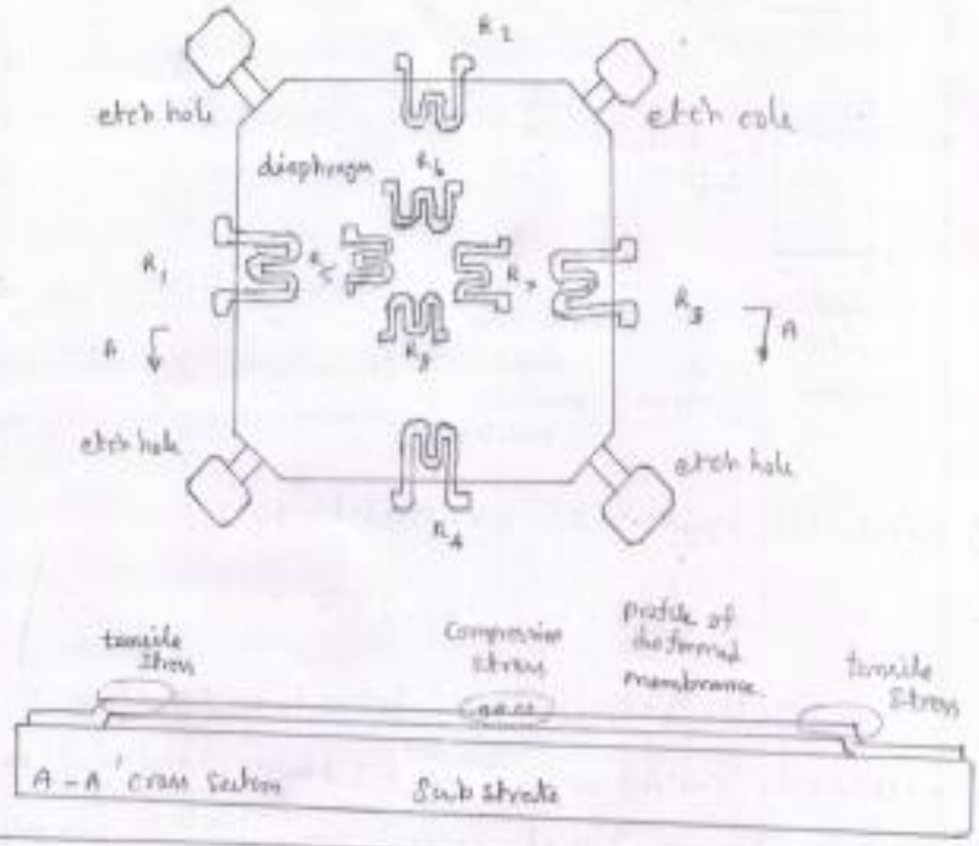
$$\frac{\Delta R}{R} = k.S = k.\delta.T = \pi.T$$

k the gauge factor as defined in Equation π the piezo-resistivity (m^2/N) and δ and T the mechanical strain and tension in the material, respectively. This is a simplified expression the piezoresistive coefficient depends strongly on the direction of the applied force relative to the crystal orientation

9) Explain Gyroscopes ?

Micromachined gyroscopes are constructed like wise they basically consist of a vibrating mass connected by a thin beam to the sensor base. The micro mass vibrates in resonance mode & the corresponding bending of the beam is measured in two directions. Upon rotation of the structure the suspension undergoes torsion that is measured by piezoresistors integrated in the suspending beam. when the structure rotates the vibration modes change, resulting in a phase shift of the bridge signals.

10) Draw cross section view of silicon micromachined pressure sensor.



SIXTEEN MARK QUESTIONS

1) Explain working principle of piezo resistive sensor
2) Elaborate and list out the materials used for piezoresistive sensor
3) Discuss about application to inertial MEMS devices?
4) Narrate about tactile sensor and its fabrication process?
5) How pressure sensor and flow sensors working? explain with neat diagram?
6) Describe about piezo electric sensors with its application
7) Elaborate with neat diagram, applications of tactile sensors?

UNIT IV- MICROMACHINING

TWO MARK QUESTIONS AND ANSWERS

1. What is mask ?

mask is usually a glass plate with a Chromium pattern. The "windows" through which to each the masking layer are defined in this mask. Emulsion masks can also be used. They are cheaper but do not last long. If it is one time use. even a laser printed printed pattern on an overhead transparency can be used as a mask.

2) what are the techniques used for thin film deposition ?

PVD : physical Vapor deposition
CVD : Chemical Vapor Deposition
Sputtering
Epitaxy
Electroplating

3) what are major of categories of micro machining techniques?

1. Bulk micro machining
2. Surface micro machining
3. micro - molding processes.
4. Non - Lithography based localized micromachining.

4) Define etch rate and selectivity ?

$$\text{Etch Rate} = \frac{\text{Thickness before etch} - \text{Thickness after etch}}{\text{Etch time}}$$

$$\text{selectivity} = \frac{\text{Etch Rate of material 1}}{\text{Etch Rate of material 2}}$$

5) Define uniformity and undercut ?

Uniformity = $\frac{\text{Maximum etch rate} - \text{minimum etch rate}}{\text{Maximum etch rate} + \text{Minimum etch rate}}$

Undercut is the lateral distance per side under the mask as shown in Figure. It can be described by the etch rate anisotropy, given by

Anisotropy is given by $A = 1 - \frac{R_L}{R_V}$

6) Define etching, mention its classes ?

In order to form a functional MEMS structure on a substrate, it is necessary to etch the thin films previously deposited and/or the substrate itself. In general, there are two classes of etching processes.

1. wet etching
2. Dry etching

7) what are the merits and demerits of wet etching ?

ADVANTAGES

Simple equipment
High throughput
High selectivity

Disadvantages

1. Isotropic etching leads to undercutting
2. Chemical costs are high
3. Disposal costs are high
4. Hot chemicals create photoresist adhesion problems
5. Critical etch time, dimensions change with etch time, bias develops

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8) List the merits and demerits of dry etching?

ADVANTAGES

① Uses small amounts of chemicals.

② Isotropic or anisotropic etch profiles.

③ Eliminates handling of dangerous acids and solvents.

④ Less undercutting.

DISADVANTAGES

① Some gases are quite toxic and corrosive.

② Re-deposition of non-volatile compounds.

③ Need for specialized (expensive)

9) What are problems with bulk micro machining technique?

① Extensive real estate consumption

② Difficulties in etching at convex corners

③ Difficult in preparing the mask with high precision

10) What are the problems associated with the surface micromachining?

① adhesion

② Interfacial stress, and

③ stiction

11) List out the few combination of structural and sacrificial materials in micromachining process?

Structural material	Appropriate sacrificial
Aluminium	Silicon
Copper	chrome
Nickel	Chrome
Poly silicon	silicon dioxide
polyimide	Aluminium
silicon dioxide	poly silicon
silicon nitride	polysilicon

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SIXTEEN MARK QUESTIONS:

1). Name and explain the three most commonly used micro machining techniques?

2). What is etching? Explain with diagram?

3). Describe the wet etching process using a suitable schematic

4). What is isotropic etching?

5). Define selectivity ratio?

6). Explain the process of dopant controlled etch stop?

7). Write about ①. RIE. ②. DRIE

8). Write about gas phase etchants.